The Australian and New Zealand Journal of Surgery

APRIL, 1946.

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Royal College of Surgeons of England.

PRIMARY FELLOWSHIP EXAMINATION IN AUSTRALASIA.

NOTICE is hereby given that a primary examination in anatomy (including normal histology), applied physiology and the principles of pathology, for the Fellowship of the Royal College of Surgeons of England will be held in Australasia in January, 1947. The written section of the examination will be held in Melbourne, Sydney and Dunedin on January 6, 1947. The oral section will be held in these centres during the month of January, 1947. The exact dates of the oral section will be announced later. The entry fee is £35 sterling. The date on which entries close has not yet been fixed, but this information, together with copies of the regulations, schedules of the required certificates, and further particulars, will shortly be available from the Secretary of the Royal Australasian College of Surgeons, Spring Street, Melbourne. Any medical graduate desiring to enter for this examination is asked immediately to communicate with the Secretary of the Royal Australasian College of Surgeons.

H. G. WHEELER,
Secretary,
Royal Australasian College of Surgeons.

Spring Street, Melbourne, C.1.
June 29, 1946.

JACKSONIAN PRIZE.

CABLED ADVICE has been received that the subject of the Jacksonian Essay for 1947 is "The Surgery of the Lower Œsophagus and Cardiac End of the Stomach". Full details governing the conditions of the prize may be obtained from the Secretary of the Royal Australasian College of Surgeons, Spring Street, Melbourne, C.1.

Editorial Notices.

ALL articles submitted for publication in this journal must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

Authors are requested to submit two typescript copies of all articles.

References to articles and books should be carefully checked. In a reference the following information should be given without any abbreviation: initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given, with full date in each instance.

When illustrations are required, good photographic prints on glossy gaslight paper should be submitted. Line drawings, charts, graphs and so forth should be drawn on thick white paper in indian ink. Authors who are not accustomed to prepare drawings of this kind, are invited to seek the advice of the Editor if they are in any doubt as to the correct procedure. Skiagrams can be reproduced satisfactorily only if good prints or negatives are available.

Editorial communications should be addressed to the Secretary of the Royal Australasian College of Surgeons, Spring Street, Melbourne, C.1. It is understood that original articles forwarded for publication are offered to THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY solely, unless the contrary be stated.

Reprints can be supplied at cost price; the minimum number is fifty copies. Orders for reprints must be given when the proof is returned.

Exchange journals should be addressed to the Honorary Librarian, Royal Australasian College of Surgeons, Spring Street, Melbourne, C.1, Victoria, Australia.

Business communications and remittances should be addressed to Butterworth and Co. (Australia) Ltd., 6-8 O'Connell Street, Sydney.

The announcements appearing in this journal contribute largely towards the maintenance of the high standard of the publication. It is, therefore, requested that, wherever possible, readers will support the business houses whose advertisements appear in the journal and that, when placing their orders, they will mention THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY.

THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY

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THE SURGICAL LESSONS OF THE LAST FIVE YEARS OF WAR AND THEIR APPLICATION TO POST-WAR SURGICAL PRACTICE.[1]

By VICTOR HURLEY.

Air Vice-Marshal, Royal Australian Air Force.

INTRODUCTION.

WHEN the date of this meeting was arranged, none of us could foresee that it would fall on the very day on which the capitulation of the last of our enemies was announced.

In a discussion on some of the advances in surgery during the war, and also the extent to which they can be applied to civil practice, time will not permit more than a brief review of some of the main general principles. It will not therefore be possible to discuss in detail the surgical problems of special regions, such as chest, abdomen, head *et cetera*. Many of you have had experience of military surgery in this war, and what I have to say is largely based on a comparison of the present position with that as some of us knew it in the 1914-1918 war or World War I.

At the outset it has to be remembered that surgical procedures in war may need to be conditioned to suit the military situation, whether the army is advancing or retreating, or whether it is imperative to evacuate casualties, often at very short notice, along the lines of evacuation. In civil practice the conditions are more of our own making, and the surgeon can personally follow the course of treatment throughout and note the end results.

In World War I many of our surgeons served in various capacities during their period of service, as regimental medical officers, in the field ambulances, and also as surgeons at casualty clearing stations and base hospitals. At times it seemed that their special training and experience were wastefully used, but on the other hand they gained valuable experience in the various stages through which the wounded passed on their way back from the front line to the base. In the enlarged medical services of World War II surgeons have been in greater demand, and on the whole have been employed more on purely surgical duties.

Possibly because I had some experience in administration in the last war I have been chiefly engaged in that capacity in this war. I have had, however, rather unusual opportunities during my visits over the last five years to Australian and American army and air force medical units, both in opera-

[1] Read at a meeting of the Royal Australasian College of Surgeons at Adelaide on August 15, 1945. Accepted for publication on September 13, 1945.

tional areas and on the mainland, to observe and to compare the methods employed in the various services.

Past experience has shown that each war presents its own surgical problems, and the procedures employed in coping with them may not always safely be followed in their entirety in subsequent military or civil practice unless the basic underlying principles on which they have been based are clearly appreciated. Fundamental surgical principles, however, operate throughout, and these must be clearly differentiated from non-essential and unimportant variations in procedure and technique.

Associated with the waste and destruction of war, especially as it is now waged with weapons of ever-increasing complexity and lethal power, there occur forced and greatly accelerated developments in technical and scientific knowledge. The stimulus of an all-in national struggle produces results in a comparatively short period which would take many years to accomplish in the less highly organized times of peace. During war, scientific workers, equipment and funds are mobilized with little regard to cost. In addition, the tremendous organization of modern armies, including their medical services, provides opportunities for comprehensive observations on large numbers of people as well as for ready dissemination of knowledge on a much wider scale than obtains in civil life.

SOME GENERAL COMPARISONS BETWEEN THE CONDITIONS OF WORLD WAR I AND WORLD WAR II.

The type of warfare and the weapons used have been widely different. On the whole, the wounds in World War II seem to have been more severe in type but less contaminated than those met with in the trench warfare which went on for the greater part of World War I. Earlier and more effectively organized surgical treatment has been provided in the forward areas. Resuscitation arrangements have been more highly developed, and blood, blood serum and plasma have been freely available. Air transport has been used on a large scale to move casualties rapidly from forward areas to large, completely equipped hospitals on the lines of communication and on the mainland. The benefits of present chemotherapy since the introduction of the sulphonamides and penicillin have profoundly altered the outlook and treatment of wounds and of surgical infections, as well as of certain diseases of infective origin which previously took a heavy toll.

Burns have been more frequent with the increased use of aircraft, tanks, incendiary bombs *et cetera,* and also because of the accidents with the highly inflammable fuels used by internal combustion engines in ships, aeroplanes and various kinds of armoured fighting vehicles and mechanical transport. Plastic surgery has been further developed from the work done in the last war by Gillies, Newland, Maclure and others, and its underlying principles are more generally appreciated by general surgeons working in field hospitals.

For these reasons the mortality rates amongst wounded men have been considerably reduced. Fortunately, however, the total number of our wounded has also been much less in World War II, although a much larger number of men have been engaged in fighting for a longer period.

WOUND SHOCK.

Many discussions on war surgery seem to begin with a consideration of wound shock, which is the underlying factor in all serious cases and which has to be dealt with before any of the more specialized procedures can be undertaken.

Finality has still not been reached in explaining completely the various clinical manifestations of shock on a physiological or pathological basis.

There is, however, a clearer appreciation of the difference between shock due to burns, blast injuries *et cetera*, with no blood loss, and shock due to wounds, in which associated hæmorrhage is often the predominating factor. In both types, however, it is generally agreed that a major factor is a reduction in the circulating blood volume (oligæmia), which needs to be restored by treatment.

In those cases of shock without hæmorrhage the reduction is believed to result from loss of plasma externally, as in burns, or into the traumatized area. The extent of plasma loss and also an assessment of the amount of plasma or serum required to restore the blood volume can be readily determined with reasonable accuracy by hæmatocrit and hæmoglobin estimations.

In cases of shock, either with or without hæmorrhage, the outstanding clinical features are lowered blood pressure, pallor and rapid pulse of poor volume. Sometimes it happens in cases of shock and, still more surprisingly, in sudden hæmorrhages, that an appreciable time may elapse before the effects of these are reflected in the pulse rate or in the blood pressure. The loss of up to two pints of blood may be well tolerated and lead to only a slight fall in arterial blood pressure, a further fall being prevented by vasoconstriction, chiefly affecting the skin and the splanchnic areas.

When blood is lost, absorption of tissue fluid tends to restore the blood volume, but this is a relatively slow process, taking two or three days to complete. In the first hour or two after the wound, no matter how severe the blood loss may have been, the hæmoglobin percentage is seldom reduced by more than 15%, and therefore the hæmoglobin level soon after the injury is not a true index of the extent of the blood loss.

BLOOD TRANSFUSION.

The indirect citrate method of blood transfusion is still the standard method, being easy, foolproof and generally available, and a very small amount of equipment is necessary. I sometimes feel we have made it rather complicated, but the "Soluvac" type used by the Australian services has proved very satisfactory. The gauze filters have given trouble by their liability to get blocked and so to interrupt the smooth flow from the bottle. A recent fine-mesh metal filter is more satisfactory. Methods of direct transfusion, in which whole blood unmixed with citrate is used, have been greatly improved. A particularly effective apparatus is that devised by Dr. Julian Smith, senior, of Melbourne, which has been used a good deal in the services by enthusiastic medical officers who have learnt how to use it. It is claimed that the use of blood without any chemical anticoagulant added may be more effective in such conditions as hæmatemesis, in which, in addition to the need to replace the lost blood, natural clotting has to be relied on to stop the bleeding.

Blood Groupings.

The matter of blood groupings has become more complicated by the addition of several subgroups and by the recent work on the Rh factor. Greater emphasis is now placed on the need for direct testing between the bloods of recipient and of donor before transfusion. Under emergency conditions, however, the use of a donor of the same group as the recipient, or a universal donor (O4) without preliminary direct testing is quite satisfactory and is still practised both in our own and in the American services, except in those cases in which transfusions from other donors have previously been given and antibodies formed, and also in transfusions for blood diseases. It is a remarkable fact that the number of reactions due to incompatibility are less than one would expect on the basis of mathematical probability. There are

grades and degrees of incompatibility. Even in cases in which incompatible blood is transfused there are usually sufficient warnings early in the transfusion—pain in the back, precordial oppression and distress—and if the transfusion is suspended on these warning signals little harm usually results. Hæmoglobinuria follows, but it was stated by Hamilton Fairley several years ago that infusions of incompatible blood up to 350 cubic centimetres in amount had never caused death, while amounts of 540 cubic centimetres and over had proved fatal. It seems that there is a definite limit to the capacity of the body to dispose of the products of hæmolysis. Extracorpuscular hæmoglobin acts as a foreign substance in the circulation and is deposited as methæmoglobin and acid hæmatin in the renal tubules. Nevertheless, whenever time and circumstances permit, it is advisable to do a direct test before transfusion.

Gum arabic and other similar substitutes have been completely discarded. If blood is not immediately available, serum and plasma are the best substitutes and are now usually available in larger centres.

Storage of Blood.

The collection, storage and transport of blood over long distances have been highly organized in Australia, largely by the work of the Australian Red Cross Society. The mobile blood banks, first used in the Middle East, led the way, but have now largely been replaced by the transportation by air of blood (O4) kept at low temperatures in specially constructed insulated boxes—O4 blood of high agglutinin titre may be excluded. In this way blood has been transported from the mainland of Australia to the islands in the Pacific, and from the west coast of America to the Philippines. The limit of the use of such blood is twenty-one days, and it is essential that an impeccable technique should be used in its collection and bottling. In operational areas, however, the chief source of supply, as in civil practice, is by the use of donors on the spot.

Blood Donors.

Donors with a known history of malaria should not be used, but in malarious areas, where all personnel are taking, or are supposed to be taking, "Atebrin" the malaria is suppressed and not to be detected by clinical examination or by blood films. From recent observations it seems that if blood containing malarial parasites has been used and if the recipient is placed on "Atebrin" treatment this can apparently be relied on to protect him from developing infection.

Rate of Transfusion.

In cases of acute blood loss in healthy soldiers blood can and should be given more rapidly and in larger amounts than was previously thought advisable. Also in some cases of severe shock venospasm may prevent the inflow of blood by the usual gravity method and it may be necessary to overcome this by the judicious use of positive pressure applied to the bottle containing the blood. Once the spasm is overcome, ordinary gravity means will suffice. Care must be taken with the use of positive pressure to guard against the possibility of air being forced into the vein and producing air embolism.

Plasma and Serum.

The use of plasma and dried serum has been a development of the utmost value. Plasma can be kept for much longer periods than blood, and dried serum can be kept almost indefinitely. It is also transportable under ordinary

conditions without any special arrangements being necessary. The chief value of plasma and dried serum is in cases in which there has not been blood loss, as in cases of burns, and also in desperately urgent cases of wound shock and hæmorrhage, in which they can be used to cope with the situation while arrangements for blood transfusion are being completed.

TREATMENT OF SHOCK.

With regard to the general treatment of the shocked patient, it seems very doubtful whether the prolonged application of external heat from electric light cradles and the like do any real good. Actually they often seem to cause deterioration in the patient's condition, and patients usually feel most uncomfortable and often distressed during their use. The increased skin temperature produces vasodilatation and withdraws still more blood from the already depleted general circulation in amounts estimated to be up to as much as a litre. The sweating which also often occurs leads to still further fluid loss. It therefore seems preferable to wrap the patient up in warm blankets to conserve his own body heat and not to overdo the heating or baking. The elevation of the foot of the bed on blocks in cases of shock, which is designed to make more blood available for the cerebral centres, is also frequently overdone, as the benefit resulting from the increased cerebral blood supply may be more than offset by the embarrassment of respiration and of cardiac action produced by the upward pressure and displacement of the diaphragm by the abdominal organs.

HÆMORRHAGE.

In dealing with cases of hæmorrhage due to wound or injury, the surgical maxim still holds good of going for the bleeding spot, aided when necessary by temporary control of the circulation by tourniquet or by temporary occlusion of the main vessel. This applies in cases of primary as well as of secondary hæmorrhage. In some deep wounds, in which special difficulties of access exist, such as neck, buttock, pharynx, buccal cavity and base of the skull, proximal ligature may be required either in dealing with the initial hæmorrhage or with repeated or threatened secondary hæmorrhage (for example, the tonsil). It has recently been pointed out[a] that, when a large artery has to be ligated, the ligature should preferably be applied immediately distal to the next highest branch given off by it and also just proximal to its next lowest branch. The artery should then be divided between the ligatures or the intervening part resected. By so doing, blind ends are avoided, vaso-spasm is lessened and the risk of clot emboli is diminished. As the cut ends of the artery retract, the ligature remains more secure when the artery is divided than when it is ligated in continuity. The smaller vessels in the line of approach should not be damaged, for it is on these that the collateral circulation largely depends.

Makin showed in the last war, and experience in this war has confirmed his finding, that the chances of survival of the limb after ligature of the main artery are improved if the accompanying vein is also ligated. This is especially true of the popliteal artery, which has an unenviable reputation in respect of gangrene of the leg following its ligature.

Repair of Arterial Wounds.

No further practical progress has been made with methods, such as the use of Tuffier's tubes, to connect the divided ends of a wounded artery in an attempt to maintain the circulation through it. A tied-in vitallium tube lined by a segment of vein has recently been suggested. On technical grounds the procedure is not often possible, and even if achieved, thrombosis usually

occurs at the site. Repair of arterial wounds by suture is also rarely practicable either in war or in peace, and ligature of the injured artery with the minimum of interference with the peripheral circulation is usually the standard treatment.

Care of the Limb.

Anaerobic infections are especially likely to occur in these limbs in which the main arterial supply has been interrupted. In such cases it has been advised that a rapid blood transfusion, by increasing the blood pressure and forcing open the capillaries, may conserve the vitality of the tissues by increasing the amount of blood reaching them. The circulation in such limbs may be further assisted by keeping them at heart level on pillows so as to reduce any additional strain imposed on the circulation as a result of gravity.

It has been shown that the blood required by a muscle at high temperature is many times greater than that demanded at low temperature; in other words, the metabolic requirements are much greater at higher temperatures. It would therefore seem advisable that the metabolic processes in a limb with a reduced circulation should be kept to a minimum while the circulation is on the borderline and the collateral circulation is developing. This can be done by keeping the limb cold by packing it in ice or using cold compresses while the rest of the body is kept warm. Pain in the limb is also reduced or abolished by keeping it chilled, and Allen and others have made use of this in the method of refrigeration anæsthesia, in which a tourniquet is applied to a limb to be amputated and the limb itself packed around with ice. Amputations have been carried out by this method without the use of any other anæsthetic agent, and it has chiefly been employed in cases of diabetic and senile gangrene. Cases of gas infection have been reported after the use of this method, and in some cases the organisms were found to be present in the ice.

TREATMENT OF WOUNDS.

The necessity for early and effective excision of wounds, which was firmly established in the last war, has been amply confirmed by further experience. The external skin wound should be enlarged, preferably in the length of the limb, the deep fascial envelope freely opened and the removal of tissue especially directed to damaged, soiled and devitalized muscle. Skin need be only sparingly removed. After excision the wound is left open or lightly filled with paraffin or "Vaseline" sometimes applied on gauze, and an external protective dressing is applied. Sulphanilamide or sulphathiazole powder insufflated into the wound is not so largely used as formerly, for reasons to be mentioned later. One of the objections to its routine use, and it is a serious one, is the sensitivity which is set up in a considerable proportion of cases. This is especially so in skin wounds and superficial infections, and was an important point in the Pacific theatre of war, where dermatitis of various kinds under tropical conditions was one of the most frequent causes of invalidity.

USE OF PENICILLIN.

When penicillin became available, it was established that it and the sulphonamides were chiefly effective because of their presence in appropriate concentration in the body fluids and not because of their local action on the exposed tissues. A more effective action of the drugs is obtained by giving the selected sulphonamide by the mouth and penicillin by intramuscular or less often by intravenous injections. The routine use of sulphanilamide powder in superficial wounds or infections is officially deprecated, although in deep muscle wounds or in compound fractures it is still employed either by

itself or in combination with penicillin (penicillin 200 units, sulphanilamide 1·0 gramme).

The instillation of penicillin solution at regular intervals through small rubber tubes leading down to the depths of the wound has given good results, but has been largely replaced by penicillin given parenterally. It was found that, even with the most scrupulous technique, secondary infection frequently occurred via the tubes by penicillin-resistant organisms, particularly *Bacillus pyocyaneus* and *Bacillus proteus,* and these are very resistant to treatment. The amino acridines seem to be especially useful in dealing with these, especially the later colourless derivatives—for example, 5-amino-acridine, in which the pH is such that the drug does not tend to damage or devitalize the tissues.

As penicillin has become more readily available, it has been used in an increasing proportion of cases. Because of its rapid excretion, it has to be frequently injected, and it is usually given intramuscularly at three-hourly intervals in doses of 10,000 to 20,000 units. These three-hourly injections have been given when required by Royal Australian Air Force nurses in air ambulances during flight. The frequent injections disturb the patient's rest and attempts are now being made to put up penicillin in a less absorbent medium to delay its absorption and excretion. It is also frequently given intravenously, especially in combination with other transfusions of fluid. This method is rather tricky, requires a good deal of attention, and sometimes sets up thrombosis.

Secondary Closure of Wounds.

Even with the entirely altered outlook since the introduction of penicillin, the same surgical principles as before still apply in regard to the initial surgical treatment of the wound. Penicillin cannot be expected to deal with infections in wounds due to necrotic tissue, sloughs and foreign bodies. The excised wound is left open and not closed earlier than the fourth or fifth day. Earlier closure is possible with the use of penicillin than when sulphonamides only were used, when the period was more often two to three weeks. The need for bacteriological examination before delayed or secondary closure of the wounds in cases so treated is not now universally regarded as essential. The evidence of healthy granulations—healing epithelial edge and absence of clinical evidence of infection—may be accepted as sufficient for suture to be carried out safely without detailed bacteriological examination. In the suturing of the wound, it is important to avoid leaving dead spaces, and catgut or other foreign material should not be left in the depths of the wound.

Pyrexia with Penicillin.

In some cases there may with penicillin treatment be a curious intermittent pyrexia while treatment is in progress in patients apparently well and whose wounds show none of the signs of inflammation. In these cases no other infective foci may be present to cause such a rise in temperature, which often subsides when the drug is stopped. Actually in one series of reported cases so regular was the return to normal temperature after the withdrawal of penicillin that, if it continued, the presence of some undeclared localized infection was suspected and usually demonstrated. The pyrexia was most definite in cases in which the drug was given by continuous intramuscular or subcutaneous drip and a considerable quantity of saline solution was used as the vehicle; but it also occurred in the cases in which intermittent intramuscular injections were given. Another observation has been that patients who feel well, cheerful, with good appetite, may actually look ill and appear worse than they really are. The pulse rate was a more reliable guide to the patient's condition than the temperature chart.

Bacteriological Examinations.

In a large series of cases recently reported by a group of surgeons who had worked in North Africa and Italy as well as with cases from Normandy, there were certain differences in the results of the bacteriological examination of the wounds. In the North Africa and Italy cases cultures usually showed hæmolytic streptococci, except in a few cases in which penicillin had been used, and these were uniformly free from this organism. It was also exceptional to find hæmolytic streptococci in the wounds of penicillin-treated patients from Normandy, in which *Bacillus proteus* and *Bacillus pyocyaneus* were rather prevalent.

In cases showing signs of infection, and in which the patient was not treated with penicillin before admission to hospital, the systemic administration of penicillin rapidly changed the appearance of the wound, œdema and induration subsiding within twenty-four hours and the tissues becoming soft, mobile and painless. While penicillin has made no difference to the importance of early and adequate surgery, it may mask the extent of infection of the tissues and make it difficult to judge the real severity of the damage which has been done and how extensive radical surgery may need to be.

Methods of Administration.

Another valuable addition to technique has been the administration of a single large systemic dose of 50,000 units of penicillin, the so-called "boost dose", immediately before any procedure involving the disturbance of an infected wound or the manipulation of an infected fracture. This single dose seems to give protection against the reaction or flare of infection which otherwise so often results.

Penicillin given parenterally cannot pass in any appreciable quantity through the synovial membranes of joints, the pleura or peritoneum or the meninges. Therefore in infections of joints, for example, or of the pleural cavity, the penicillin must be injected into the joint or pleural cavity, as the case may be. After aspiration of an infected joint, penicillin in solution should be injected into the joint cavity, and any extrasynovial infection is dealt with by systemic therapy. Similarly, in the pleural cavity the infected fluid of an empyema can be dealt with initially by aspiration, repeated every two or three days, and after each aspiration by the introduction of 10,000 to 20,000 units of penicillin. Operation and drainage (either closed or open, as deemed necessary) will, however, be required in most cases and should not be deferred too long, because the pleural thickening and fibrosis of the underlying lung may prevent the reexpansion of the lung. The usual criteria demanding operation are still much as heretofore—increased thickening of the pus making aspiration unsatisfactory, increased pleural thickening, presence of large amounts of fibrin, and evidence of non-expansion of the lung. Careful clinical examination and X-ray films will usually give the evidence on which the decision to operate can be made, and although the proportion of patients now requiring drainage is less than previously, especially among children, it is still true that thick pus in a closed cavity, such as the pleura, requires drainage before recovery can take place.

The same general principles also apply in the treatment of cases of infected hæmothorax.

With these powerful chemo-therapeutic agents available, it is only to be expected that their use will continue to be more and more extended, the ultimate results being determined, as with other new methods, by trial and careful clinical observation and assessment of the results obtained. The possibility of internal fixation of compound fractures and even of early bone

grafting in special cases under penicillin therapy is at present under trial; but it is too early to speak of the results, or to be assured that this will succeed when previous attempts along these lines have hitherto usually resulted in failure or disaster.

Bacterial Endocarditis.

On the medical side, a recent development has been the use of penicillin in massive doses of five million units or more in association with heparin in the treatment of bacterial endocarditis. Some early spectacular results have been recorded in a large series of cases by American observers. It may also be of great value in combination with surgery in those cases of patent *ductus arteriosus* associated with endocarditis. In endocarditis, penicillin has to diffuse into the vegetations and a certain concentration in the blood is necessary for a long period.

LOCAL AND SYSTEMIC CHEMOTHERAPY.

Indications.

Wounds in civil practice will rarely show the same degree of severe devitalization of tissue or of such contamination by infected material and foreign bodies as are met with in war wounds as a result of high explosives, blast *et cetera*. What the atomic bomb will do is a matter of interesting speculation; perhaps there will be no wounded at all. However, the principles tested and proved in war surgery in dealing with wounds should be the guiding ones in practice in dealing with severe accidents, compound fractures *et cetera*.

In civil practice it will not be possible or necessary to institute a full penicillin regime for all cases, and it is therefore of some value to discuss briefly the place of local chemotherapy as opposed to systemic chemotherapy.

As already stated, both the sulphonamides and penicillin act as bacteriostatics by reason of their presence in sufficient concentration in the body fluids. They are both rapidly absorbed and excreted, there being, however, a good deal of individual variation between the various sulphonamides in this regard. There is also evidence that the sulphonamides and penicillin are not antagonistic, but seem to reinforce each other. The types of organisms which are sensitive to each of them are rather different, although many are common to each group. It also seems that penicillin may be to some extent bactericidal as well as bacteriostatic.

The sulphonamides are easy to administer, are usually given by the mouth, are stable and are always available. Agranulocytosis and renal suppression from the deposit of crystals in the urinary tract have to be carefully watched for, and the administration of alkalis in association with sulphonamides is of advantage. Enough fluid must be given during their administration to ensure a daily urinary output of at least fifty ounces.

Staphylococci and spirochætes are susceptible to penicillin, but not to the sulphonamides. The sulphonamides are better for *Bacillus coli* infections, which are sulpha-sensitive and penicillin-resistant, and are therefore better for peritonitis, or pre-operatively or post-operatively in resections of the colon, rectum *et cetera*.

Results of Local Chemotherapy.

In a recent series of cases[2] published by the Penicillin Control Team of the Central Mediterranean Force, observations were made on the control of infections in recent wounds by surgery supplemented by local chemotherapy.

A previous series had shown that, of 85 wounds operated on at casualty clearing stations and treated with sulphanilamide into the wound, 57% were

infected on arrival at the base several days later, whereas of 61 wounds that had received penicillin-sulphanilamide powder, 26% were infected. It has to be realized, of course, that the local action of powder thus introduced into wounds must necessarily be uncertain and variable, because it may be washed out of the wound by bleeding or free escape of fluid, and the drier the wound the longer will it make effective contact with the tissues. In some cases tablets of sulphanilamide had been given to the wounded at the casualty clearing station and during their journey to base hospital. The majority of wounds were not disturbed or redressed between the operating theatre in the casualty clearing station and examination in the base hospital theatre.

Staphylococcus aureus was found to be by far the most common pyogenic coccus; *Streptococcus pyogenes* was found in 6% of all wounds.

Of 100 wounds examined at the casualty clearing station before operation was begun, pyogenic cocci were found in 51. This was regarded as the basic infection rate against which surgery and chemotherapy were to be employed.

The results were studied at the base hospital in 706 wounds in which the dressing had not been disturbed between the casualty clearing station operating theatre and the base hospital, and were as follows:

1. With operation only and with no bacteriostatic agent being used, 49% of wounds were infected.
2. With operation and sulphanilamide powder, 43% of wounds were infected.
3. With operation and penicillin-sulphathiazole powder, 25% of wounds were infected.

These comparative figures held good for simple as well as for serious wounds; there was no tendency for the result to be influenced by the severity of the wounds.

Operation alone without the use of a bacteriostatic did as could be expected—it removed the grossly damaged tissues, provided adequate incisions and drainage, and left the tissues in the best condition for dealing with the infection that remained. Although many were infected, the sepsis was chiefly confined to the surface layers of the wound and did not spread along the limb or track deeply.

Redressed wounds showed a higher rate of infection than those whose dressings had not been disturbed—42% against 25%.

There was some lack of correlation between the clinical appearances of the wound and the presence of pyogenic cocci; some apparently clean wounds contained *Staphylococcus aureus* and many dirty wounds yielded no pyogenic cocci on culture.

The majority of the 706 wounds in this series were sutured at the time of their first examination in the operating theatre of the base hospital. Penicillin was given as a routine measure either by insufflation of penicillin-sulphathiazole powder, or by subsequent instillation of a solution of penicillin through tubes into the sutured wound. The results were as follows:

Of 614 clean wounds, 424 were free of pyogenic cocci; 85% obtained grade 1 union.
Of 190 wounds which were infected (pyogenic cocci present), 62% obtained grade 1 union.
Of 101 dirty wounds (covered with tissue exudates, 52 free of pyogenic cocci), 80% obtained grade 1 union.
Of 49 infected and dirty wounds, 37% obtained grade 1 union.

No doubt for the reasons already mentioned, parenteral penicillin would give still better results than these.

DRESSING OF WOUNDS.

Considerations of results such as the above confirm what many have believed for some time, that, generally speaking, wounds are overdressed. Daily change of dressings, which was at one time the usual practice in

"clean cases", is no longer necessary or advisable. Such wounds heal better if the original dressing applied in the theatre after operation is left until the sutures are due for removal.

In wounds which have been effectively excised, in which local chemotherapy has been used, and which have then been left open, the initial dressing need not usually be removed until the fifth or sixth day, and then, under thorough aseptic technique, with the use of gown, mask, gloves and a no-touch technique as far as possible, the dressings are changed. Cross infections readily occur in the wards, and the staff are the chief means of spreading them; the opportunity is provided each time the wound is exposed. The details of the necessary procedures have been outlined in various papers on the subject and can be readily devised. They include such matters as having all ward sweeping, cleaning, changes of bedclothes *et cetera* carried out well in advance of the time for exposing wounds. Winnett-Orr first used this principle in the treatment of cases of acute osteomyelitis, and Trueta adopted it also in his closed plaster technique.

When delayed or secondary suture is carried out, usually before the end of the first week, the dressings can again, with advantage, be left undisturbed for several days, usually until the sutures are due for removal. It will take some time, however, to educate patients to the fact that frequent dressing of their wounds is not necessary and is not necessarily to be regarded as evidence of solicitous care on their behalf.

Importance of Skin Covering for Wounds.

In cases in which skin has been lost it is important to provide skin cover as soon as possible. Even in those cases of extensive skin loss in which it is evident that some form of skin plastic operation will later be necessary, it is advisable to cover large granulating wounds with split skin grafts as a temporary measure until circumstances are favourable for the plastic operation. By so doing, much fibrosis and scarring can be avoided with less subsequent deformity, and earlier and increased usefulness of the injured member results. Split skin cut into pieces like a postage stamp is on the whole preferable to pinch grafts, which leave unsightly scars both at the site of removal and of application.

Immobilization.

The importance of the cardinal principle of rest for the injured part has again been confirmed as a necessary provision, not only for the comfort of the patient, but also for the healing of his wounds. The principle applies not only to fractures, but also to joint injuries and severe flesh wounds. The complete non-padded plaster cast, however, is dangerous if left unopened, and the risk is greater in closed or simple fractures. In open or compound fractures with an external wound and the fascial envelope of the limb opened up, fluid can escape from the limb via the wound. The swelling of the limb following fracture or injury with an intact skin and fascial envelope can develop great tension within the cast, which may lead to serious damage to the tissues, blistering and loss of skin in mild cases and even gangrene in the more severe cases. If it is thought necessary to apply a completely enclosing non-padded plaster cast to a limb, it should preferably be opened up at the conclusion, but, in any case, not later than the following day. It will usually, however, be possible either to apply padding here and there to protect places specially subject to pressure, bony prominences *et cetera* or else to apply the plaster in the form of overlapping slabs which leave a portion of the limb unenclosed. Detailed instructions on this subject have been circulated to medical officers of the services and they have been advised

that patients must not be transported along the lines of communication in complete unpadded plaster casts.

In the treatment of patients who are confined to bed for long periods, especially if immobilized in splints or plaster casts, it is necessary to keep up their fluid reserves and also to maintain a positive nitrogen balance. In septic cases there is often a gradual lowering of the hæmoglobin content. Hæmoglobin and plasma protein estimations can be readily carried out, the latter being usually done by Van Slyke's copper sulphate method. Hæmoglobin is the chief oxygen carrier to the tissues and its level must be maintained as near to 90% as possible. Bed rest lowers the plasma protein content, and during treatment and convalescence proteins should be supplied in sufficient amount by giving eggs, milk, cheese, easily digested flesh foods, and, in severe and acute cases, by the use of serum or plasma given intravenously.

INJURIES AND INFECTIONS OF BONES AND JOINTS.

In fractures of the thigh the Thomas splint has again proved to be the most effective. The addition of plaster especially for the transport of patients, as in the Tobruk plaster, gives greater control and immobilization. In fractures below the knee the Thomas splint is also effective. Plaster of Paris, however, is more often used and is applied after the fracture has been corrected by traction. It is especially useful for transport purposes.

Skeletal traction with wires or pins has largely replaced skin traction, although the shattered fractures of war wounds are not so difficult of control as those met with in civil practice where the damage to bone and muscle is less. It would appear that skeletal traction at the moment is rather overdone. It is not entirely foolproof, and the danger of overtraction with delayed union is not sufficiently appreciated. Care should be taken after the first few days to ensure that the traction applied is reduced and that no greater degree of traction is maintained than is necessary. Effective skin traction will meet the requirements in a large proportion of cases and is always available.

More emphasis is now placed on adequate and sufficiently maintained immobilization of fractures and less emphasis is placed on the early movement of joints. The happy medium between these two procedures varies with different bones and in the different fractures, between a Colles's fracture and between a fracture of both bones of the leg, where it may be said different priorities exist. There is also a clearer recognition of the value of maintaining the tone of the muscles of an immobilized limb, and much can be done to ensure this by controlled exercise and by physical therapy. In the services good results have been obtained and the periods of disability from various injuries have been considerably reduced by organized arrangements supervised by trained personnel in rehabilitation units, and these could well be used with advantage as adjuncts to civil hospitals.

The outlook in acute osteomyelitis, especially the form seen in civil practice, has been entirely altered with the advent of penicillin, not only in reducing the mortality, but also in the avoidance of prolonged suppuration, sequestra formation *et cetera*.

However, in the treatment of chronic osteomyelitis with infected bone cavities, treatment by penicillin both parenteral and local, without surgical intervention, is totally ineffective. Adequate saucerization and cleaning out of the cavities should be performed, and the subsequent healing by granulation does not seem to have been materially assisted by the use of penicillin given both pre-operatively and post-operatively. Healing of these bone cavities can be expedited by skin grafting applied over a mould of stent or modelling wax.

BURNS.

At the commencement of the war "tanning" of the burnt area by one or other of the available methods—tannic acid, triple dye, silver nitrate *et cetera*—was largely employed. Even before the war, however, some had their doubts of its value. Following on its introduction there is no doubt there was a reduction in the immediate mortality, chiefly due to the sealing of the burnt areas and so to the prevention of the escape of fluid. Nevertheless, even after careful cleansing of the burnt area before tanning, infection occurred beneath the crust in a considerable proportion of cases, with septic infection and much scarring and fibrosis in those who survived. The plastic surgeons especially opposed tanning methods for this reason, and most agreed that it should not be used on the hands, face and other places where scarring might produce disabling results. The "tanners" claimed that these effects could largely be avoided by early removal of the crusts bit by bit after the initial risk to life was past, and that the deep fibrosis was not due to the tanning agents if they were properly used. Other observers have also reported cases of necrosis in the liver lobules, particularly after the use of tannic acid.

It is now held that the undoubted lessened mortality which followed the introduction of tanning methods can be maintained by replacing the fluid loss by the free use of plasma and serum given intravenously, and by the use of pressure bandages applied over copious dressings. The burnt area is cleansed with mild cleansing agents; saline solution or soap and water are as good as any; dried sulphanilamide and penicillin powder may be insufflated over the area, which is covered by *tulle gras,* boroglyceride or parawax gauze, over which ordinary gauze and cotton wool dressings are applied. Dressings are floated off in saline solution baths as often as necessary, usually daily. Even in severe cases a general anæsthetic may not be required for the initial treatment; an intravenous injection of morphine, one-third of a grain, repeated if necessary, may enable the necessary procedures to be carried out even in extensive cases.

In cases of extensive burns, in which a large proportion of the body surface is swathed in bulky dressings, it is now being appreciated that with the great reduction in the exposed skin surface there may be considerable interference with the normal heat-regulating mechanism of the body. Heat loss from the body may thereby be so restricted as to lead in itself to considerable elevation of body temperature, especially under tropical conditions. This rise of temperature may occur over and above and quite independently of that due to septic infection and absorption from the burnt surface.

In one Australian hospital in New Guinea excellent results have been obtained by nursing patients with severe burns in an air-conditioned room in which the temperature was kept between 60° and 70° F. Appreciable reductions of temperature occurred in the patients so treated.

The last word has, however, not been spoken in the treatment of burns, and the early mortality in severe cases is still very high, especially in comparison with other severe injuries.

The importance of early skin grafting is stressed, particularly by the plastic surgeons, and the procedures employed and the technique have been well described in various papers on the subject.

I am afraid that much of what I have submitted is probably already well known to most of you. Nevertheless, I feel we may all gain something from a periodic stocktaking and review of our knowledge, and particularly from an exchange of views and experience, for which this meeting affords an opportunity. One of the lasting benefits which resulted from World War I was that medical officers and others from all parts of Australia worked and lived

together for long periods and got to know each other in a way which is not possible in the somewhat restricted circles in which we move in civil life. I feel sure that after this war a similar happy result will obtain and that this will be of the utmost value in the unsettled and anxious times which lie ahead for all of us, in which the post-war world and our part in it may be vastly different from what it was before.

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SOME OBSERVATIONS ON HEAD INJURIES AND THEIR COMPLICATIONS.[1]

By LAMBERT ROGERS,

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THE sulphonamides and penicillin have done much to modify treatment and to improve results in soft tissue wounds and compound fractures of the long bones. The same claim may be made for the use of these substances in compound fractures of the skull and penetrating injuries of the brain.

During the war cranial injuries have for the most part been due to: (*a*) missiles, (*b*) blast, (*c*) so-called "blunt injuries", that is, injuries caused by moving vehicles, collisions and by the hundred and one ways in which comparable injuries occur in peace-time and which are increased a hundred-fold in war-time. The missiles which cause wounds may be classified as primary or secondary; primary missiles are for the most part flying fragments of bombs or shells, occasionally bullets, while secondary missiles are materials which are dislodged and put in motion consequent upon being struck by primary missiles. Secondary missiles, therefore, comprise debris of all kinds, falls of earth, timber or dug-outs, parts of buildings or furniture and even fragments of bone or other materials struck from the living or the dead.

Head injuries may be classified as open or closed according to whether or not there has been a scalp wound. By a penetrating head injury is meant one in which the *dura mater* has been perforated and the brain wounded.

THE NATURE OF THE MISSILE.

The nature of the missile which causes the injury is highly important. In the present war light metal fragments have achieved velocities never hitherto attained. Small, white-hot pieces of metal may penetrate the skull and, being of relatively low density, soon come to rest. Many cases have been seen in which such fragments have cleanly cut their way into the brain without shattering the bone, and in some of these, because of their small and clean-cut character, it has been difficult to find the entering wound or wounds in the scalp. I have seen the brain peppered with tiny fragments of metal which have entered in this way, and also a number of cases in which odd fragments have been discovered in X-ray films taken from patients who have been quite unaware of their presence. The great majority of these metallic fragments do no harm and are best left alone.

OPEN INJURIES.

Occasionally, however, fragments which are almost spent and are travelling, therefore, at much lower velocities, strike the skull. When they do so, they do not cut cleanly as the light, fast ones do, but shatter the bone, and patients so injured are seen with wounds of scalp, bone and brain.

In one such case air had entered the skull with the missile. X-ray films not only showed a fragment of metal in the left frontal lobe, but an encephalogram which had been produced by the air entry. Brain was discharging from the wound when

[1] Based on an address delivered in Melbourne on July 20, 1945, to the Royal Australasian College of Surgeons and illustrated with lantern slides. Accepted for publication on August 20, 1945.

the patient came under my observation, some thirty-six hours after being injured in an air raid on Exeter. The wound in the scalp was excised, damaged bone removed and the brain wound irrigated and gently sucked out. The armature of an electro-magnet was then gently passed down the wound track, a click was heard when the current was turned on, and the metallic fragment was withdrawn.

If the foreign body is magnetic it may with advantage be removed in this manner, which inflicts little or no injury on the brain containing it.

Recent Advances in the Treatment of Open Injuries.

Towards the end of 1941 we heard that German surgeons were, with the aid of the sulphonamides, completely closing the dura as long as six days after a penetrating brain injury. When penicillin became available, we were able to follow this practice after even longer intervals after the wounding and the advantages of a water-tight closure of the dura after removing damaged brain soon became apparent. Defects left in the dura after excision of its damaged edges are no disadvantage, because pieces of pericranium or *fascia lata* can be stitched as a graft over the dural opening. Even penetrating ventricular injuries have been successfully treated in this manner many days after their receipt. I have followed this practice both with injuries due to bomb or shell fragments and with the compound penetrating injuries due to road accidents, and have been very pleased with the results.

Prior to the introduction of the sulphonamides and penicillin, it would, of course, have been the height of surgical impropriety to have practised such methods.

BLAST INJURY.

There is no doubt that structural damage to the brain may be produced in the vicinity of a heavy explosion. Although blast damage to the lungs and intestines has aroused a good deal of attention during the war, less attention has been paid to the effects of blast on the brain. Intracerebral hæmorrhages may result from blast and be scattered and small or more circumscribed and confined to a particular part of the brain. I have operated on one patient, a young seaman, in whom an intracerebral hæmorrhage was produced in the parieto-occipital area of the right hemisphere following the discharge of a four-inch battery near which he was standing. This and other cases have been reported and the subject discussed elsewhere (*The Medical Journal of Australia*, Volume II, 1945, page 209).

CLOSED INJURIES.

The great majority of severe head injuries, even in war-time, are of the closed variety, that is, the brain is injured by being bruised, and perhaps torn also, without an open fracture of the vault of the skull being produced. Frequently the skull base is fractured and then the middle ear or the nasal sinuses may be opened. With the treatment of the patient unconscious from a head injury I have dealt in detail elsewhere (*British Medical Journal*, Volume I, 1943, page 151), but perhaps I may restate the principles underlying treatment.

In reacting to injury the bruised brain swells as a result of the effusion of blood and œdema. If provision is made for this swelling to take place, recovery from the effects of even extensive contusion is remarkably complete. If, however, no provision is made for brain swelling, the blood supply to the swollen brain is diminished through compression of its vessels by the confined and compressed brain, and recovery is liable to be incomplete. Varying degrees of cerebral atrophy may then take place, as may be shown by a dilated ventricular system demonstrable by encephalography. The object to be

aimed at in treating patients with closed head injury therefore should be to provide space for brain swelling and to prevent intracranial venous congestion. This may be achieved by elevating the head, making sure that there is no constriction of the neck, limiting fluid intake and administering magnesium sulphate by the rectum every six hours. Rectal administration is preferable to the intravenous injection of hypertonic solutions because with it there is no alteration of the cellular elements of the blood, nor are there disturbances of the pulse, respiration or blood pressure, while magnesium sulphate, being non-dialysable and therefore not absorbed into the blood stream, does not produce a secondary wave of tissue œdema with an increase in intracranial pressure, as do electrolytes administered intravenously.

INTRACRANIAL HÆMORRHAGE.

Many textbooks make much of middle meningeal hæmorrhage and pay less attention to the more common subdural and subarachnoid hæmorrhages and little, if any, to intracerebral hæmorrhage. Clot compression of the brain may be differentiated from traumatic œdema, if the regimen already indicated has been instituted, because œdema is prevented or limited in degree and extent and the onset of focal signs during the course of such treatment therefore indicates both the presence and the location of blood clot. Middle meningeal hæmorrhage is comparatively rare, and when it occurs does not always produce the syndrome of unconsciousness, a lucid interval, coma and pupillary changes. I have operated in several cases in which this syndrome has not been present and in which the diagnosis was made because of the appearance and progressive nature of focal signs. It is, I believe, desirable to think of intracranial hæmorrhage as a single entity rather than to give undue prominence to an occasional syndrome presented by one of its varieties.

CEREBRO-SPINAL RHINORRHŒA.

If there is a persistent discharge of cerebro-spinal fluid from the nose owing to the subarachnoid space having been opened by a fracture passing through the floor of the anterior fossa, the patient is liable to develop meningitis, especially if the nasal sinuses are infected. The question of early operation to arrest and prevent infection is therefore an important one, and at the beginning of the war excited some controversy between those who favoured an immediate transfrontal operation and those who pointed out that most of these fistulæ closed spontaneously in the course of a few days and that meningitis is a rare complication. With the use of the sulphonamides and particularly penicillin, the argument for conservatism has been considerably strengthened, and it would appear desirable to wait for some days at least and to operate then only if the rhinorrhœa is persistent and showing no sign of diminishing.

DEPRESSED FRACTURE.

All depressed fractures should be elevated; if simple, at a time convenient to patient and surgeon; if compound, of course this will be done as an emergency measure. It has been stated by some writers that slight depressions of the saucer type may safely be left, especially in young subjects; but I have had a series of electro-encephalographic records taken of a child who was quite symptom free, but had an old saucer depression in the parieto-occipital region of some months' standing, and an abnormal rhythm was consistently present in this area. I believe it is wise to restore the intracranial capacity and the contour of the skull to normal.

OTHER COMPLICATIONS.

Other complications, such as hydromata, aeroceles, cysts, abscesses, and osteomyelitis of the skull are of much interest and well worthy of consideration, but time forbids this at the moment. One complication which I would mention, however, is the defective skull, that is to say, the skull of a patient who has a bony defect in the skull. Many of these cases are seen today, particularly among service personnel, bone having been removed over larger or smaller areas during the treatment of compound injuries. I believe it is advisable to close these openings for both physiological and psychological reasons and that bone is the best material to use for the purpose. The bone grafts may be taken from nearby outer table, from the iliac wing, ribs, tibia or even from old bone flaps, which may be treated in various ways (for example, *"os novum"*) before being used.

SUMMARY AND CONCLUSIONS.

In the foregoing remarks may be found an indication of the way in which experience of head injuries in the war has modified practice. Chemotherapy and particularly the use of penicillin have enabled us to effect water-tight dural closure in penetrating injuries, and although it is early to assess results, this would appear to be an advance which may conceivably lower the incidence of complications of penetrating injuries, whether produced by missiles or road accidents. The more widespread recognition of brain swelling as a reaction of the brain to blunt head injury and treatment designed to ensure provision for this swelling should also reduce the incidence of complications following this type of injury. Chemotherapy has enabled us to take a more conservative attitude towards cerebro-spinal rhinorrhœa.

ABDOMINAL INJURIES IN THE SECOND NEW ZEALAND EXPEDITIONARY FORCE DURING THE ITALIAN CAMPAIGN.[1]

By T. D. M. Stout,
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It has been thought worth while, in spite of previous excellent presentations of the results of treatment of abdominal injuries in the British Army, to give an account of our New Zealand experience. It has been possible, fortunately, to obtain complete records, and nearly always very full records, of every abdominal casualty occurring in the Second New Zealand Expeditionary Force. The cases have been fully checked and rechecked from every possible angle. A special feature of the records is that even casualties brought in dead to field units have been included, as well as all deaths occurring in forward areas, even in the regimental aid post. There can be no question of omitting any death. If any case has escaped me, it will be one in which a relatively minor injury was present and the soldier has not been boarded.

I have also, for comparison, the records of the results obtained by our surgeons who carried out the treatment of casualties with abdominal wounds during the advance of the Eighth Army in Tripoli and Tunis.

General Comment.

Study of the results gives rise to a few simple statements of fact:

1. The large majority of the deaths are inevitable from the beginning because of the severity of the trauma. Of 160 recorded deaths only 48 took place after the first forty-eight hours following the injury or operation. (See Chart I.) Even of the forty-eight deaths a quarter were due to anuria, which was, in our cases, the result of severe trauma.

2. Deaths at the base hospital are all due to infection, either shown as a frank peritonitis, as subphrenic or other abscess, or as an obstruction dependent on localized peritonitis. This sepsis is frequently shown by the occurrence of bursting of the abdominal wound.

3. There is no appreciable difference between the results obtained during the different periods of the campaign, except that there was not a single death from an abdominal wound in the base hospitals for the last eight months, and there was only one patient not satisfactorily recovered, and he expected to get well.

4. The results are remarkably similar to other recorded results, particularly those given by Major-General Ogilvie from the Western Desert campaign.

Main Data.

The total number of cases recorded is 317, all the wounded being members of the Second New Zealand Expeditionary Force. Patients not members of the Second New Zealand Expeditionary Force operated on by our surgeons or in our hospitals are excluded so as to secure completeness of records and purity of results. Second New Zealand Expeditionary Force patients operated on in other than Second New Zealand Expeditionary Force units, though very small in number, are included. We have, therefore, a complete picture of the

[1] Accepted for publication on February 21, 1946.

results in one very compact force, the operations being undertaken by many surgeons of different degrees of experience and skill.

There were 160 deaths in the series, almost exactly 50%. This includes all cases recorded in our casualty lists, of which any particulars of injury at all were obtained. It includes all casualties brought in dead to any forward medical unit, and all patients dying in the divisional medical units, even in the regimental aid post. I believe figures of this kind have not hitherto been available and would not be obtainable except in a small force like the Second New Zealand Expeditionary Force.

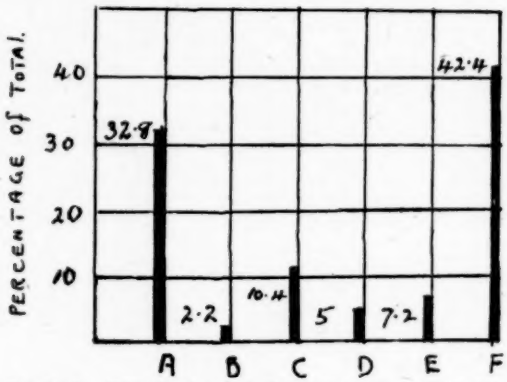


CHART I. Record of cases showing time of patient's death in relation to his admission to a medical unit or his survival. A = died in 24 hours; B = died in 48 hours; C = died later in forward areas; D = died at base; E = alive, graded A-D; F = alive, graded E.

There were in all 28 casualties brought in dead. There were 20 deaths in the divisional units among patients who had had no operation performed. Of these, one died in the regimental aid post, nine died in the advanced dressing station, and ten died in the main dressing station. There were only ten deaths in the casualty clearing stations in cases in which no operation was performed. Of these, only three occurred in the New Zealand Casualty Clearing Station. (See Chart II.)

The New Zealand practice, right or wrong, has always been to operate on any patient able to be brought to the operation table, even if the condition has appeared quite hopeless. At no time, and by no surgeon, has the question of results ever been considered. Each patient is considered as a fresh problem. We have probably gone too far in this direction, and at times taxed the surgeon's endurance too much; but there is some satisfaction in knowing that even hopelessly desperate measures were carried out to give the men even the slightest chance of recovery.

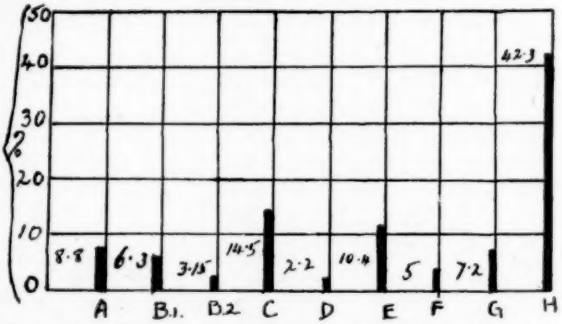


CHART II. Record of cases showing percentage of deaths at different stages and gradings of those who survived. A = dead (B.I.D.); B = died in field ambulance, B1 casualty clearing station, B2 no operation; C = died in 24 hours; D = died in 48 hours; E = died later in forward areas; F = died at base; G = alive, graded A-D; H = alive, graded E.

The figures show that of those patients admitted alive to any medical unit, including advanced dressing stations, 89·6% were operated on. Of patients admitted alive to the casualty clearing station, 96·3% were operated on. (These figures include those in other casualty clearing stations than our own.)

It is in the light of these facts that the results of operation must be evaluated. Naturally, if operation was not performed in a higher proportion of the hopeless cases the recovery rate would be much higher.

Mortality at Different Periods of the Italian Campaign.

From November, 1943, to May, 1944, there were 111 casualties with a mortality of 41·4%; from June, 1944, to November, 1944, there were 71 casualties with a mortality of 40·8%; from November, 1944, to May, 1945, there were 73 casualties with a mortality rate of 37%. It can be seen that over a period there is little difference in the results. If we take one month alone we find that in December, 1944, there were 20 casualties with a mortality of 15%, and again in July, 1944, there were 27 casualties with a mortality of 29·6%. In December, 1943, there were 27 casualties with a mortality of 33%.

Comparison with Western Desert Figures.

Among 96 cases in the Western Desert the mortality was 29%, a remarkable figure. The figures, however, are not definitely comparable because they included only two deaths at the base, and the follow-up was not possible in a large number of the cases. Only a third of the patients were New Zealanders and many were prisoners of war.

One of the surgeons had only six deaths among 32 patients, a mortality of 19%, and there were 14 colostomies in the series.

Many of the patients were evacuated from the forward areas much earlier than they were in Italy, and one must expect that there were many deaths at the base of which records were not available to the surgeons.

The Italian mortality is in keeping with other published figures and, considering the completeness of the figures, it must be considered satisfactory.

Deaths after Operation.

In the First Forty-Eight Hours.—Nearly half of the post-operative deaths occurred in the first twenty-four hours—46 patients out of a total of 102, and in the next twenty-four hours a further seven deaths occurred. These deaths are obviously due to the severity of the trauma, first of all from the wounds and secondly from the operation itself. Evidence of this is quite overwhelming and would not be disputed by anybody with experience of forward surgery. (Charts III and IV.)

Later in the Forward Areas.—A further 33 deaths were reported later in the forward areas—39% of all deaths. The most common cause of death was anuria, which accounted for a third of the deaths. Chest complications were present in four cases, peritonitis in four, and obstruction in three. The causation of death at this time still seems to be in half of the cases the severity of the trauma and in the other half the onset of infection.

At the Base.—There have been 16 deaths at the base, nearly 16% of all deaths. It is interesting to note that there has not been a single death at the base for the last eight months, as against fifteen in the previous eight months. It is speculative to wonder whether the early parenteral administration of penicillin has been responsible for this or whether, in some degree, it is due to the retention of the more severely wounded at the casualty clearing station. It is certainly a very remarkable result. The deaths at the base were all due to infection in one form or another.

Patients Who Survived.

The patients have been followed up till they were evacuated by hospital ship from Italy to New Zealand. No patient is evacuated till fully recovered;

some have been evacuated with colostomy still unclosed. The infrequency of evacuation has generally meant that the patient has remained in Italy for a considerable period after being wounded. I should think that there could have been few, if any, deaths after the patients were evacuated from Italy. One patient died on his way to Egypt following acute hepatitis. He had a small foreign body in his liver, but the post-mortem examination did not disclose any definite connexion between the foreign body and the hepatitis. The patient had been getting about freely as an up-patient outside the hospital before his evacuation. I have no knowledge of any other deaths.

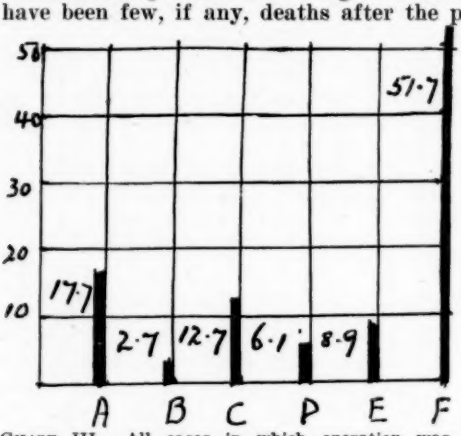


CHART III. All cases in which operation was performed. Showing percentage of patients dying at different stages and grading of those alive. A = died in 24 hours; B = died in 48 hours; C = died later in forward areas; D = died at base; E = alive, graded A-D; F = alive, graded E.

Percentage of Recovery.

Practically 50% of all patients known to have had abdominal injuries recovered. Of all patients brought in alive to any medical unit, even the advanced dressing station, over 54% recovered. There have been nearly 61% of recoveries in all cases other than those in which the patients died unfit for operation.

Cases Without Abdominal Operation.

Only eight patients have not been subjected to either an abdominal operation or a chest operation involving the abdomen. Six of these patients had minor liver injuries associated with the retention of a foreign body in the liver; one had the foreign body removed from the liver by a local operation; and the other had a chest operation for a small foreign body in the liver, without exploration of the abdomen.

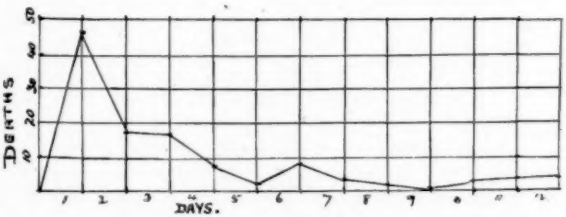


CHART IV. Showing period between operation and death.

Cases Without Involvement of a Viscus.

There were in all twenty-two patients in whom no viscus was involved. They include eight with foreign bodies in the liver, five with blood in the peritoneum, and three with retroperitoneal hæmorrhage.

There were three deaths in this series due to (*a*) amputation of the thigh with severe shock, (*b*) extensive blast injuries which caused death, (*c*) severe hæmorrhage from the internal iliac artery associated with retroperitoneal bleeding.

There were no deaths attributable in any way to "negative" abdominal exploration—a happy feature of the results. Only three patients were operated on with completely negative results—a very small proportion of the total.

Grading of Cases.

The great majority of the patients were graded and evacuated to New Zealand. Only 22 patients out of 157 were retained as graded personnel, some rising to grade A later on. Our bias was to consider that a soldier who had had a serious abdominal injury was better out of the army to make way for a fresh man.

TYPE OF MISSILE CAUSING THE ABDOMINAL INJURY.

I have been able to secure information with regard to all but three of the patients who were operated on, and all but nine of those not operated on, the latter being nearly all in the B.I.D. Section.

The results are of great interest to those with knowledge of armaments.

1. Bullets, including machine-gun bullets, caused 63 casualties with mortality of 36%.

2. Shell and mortar shell wounds occurred in 215 cases with mortality of 37%.

3. Mine, grenade and booby trap and bomb wounds occurred in 29 cases. The mortality in mine wounds was 71% in nine cases; the mortality in grenade wounds was 57% in ten cases; the mortality in bomb wounds was 43% in nine cases; and the only soldier with a wound caused by a booby trap died.

4. There was one bayonet wound; the patient lived.

It is interesting to have confirmed statistically the opinion that mine wounds are extremely serious, and also interesting that shell wounds do not cause a heavier mortality than bullet wounds as far as the abdomen is concerned.

I have also obtained particulars of patients operated on by our surgeons in the Western Desert from December, 1942, till May, 1943. The mortality from mine wounds was 44% in 16 cases; from bomb and also from bullet wounds 33% in 18 cases; and from shell wounds only 22% in 59 cases.

THORACO-ABDOMINAL WOUNDS.

There were 26 thoraco-abdominal wounds in the series out of a total of 318—a percentage of 8. Of the patients, 15 died—a percentage of 56—much higher than the average of the whole series. (i) There were three deaths in 13 cases in which operation was limited to the chest. (ii) There were five deaths and no recoveries after abdominal operations. (iii) There were six deaths and no recoveries after operations on both the chest and the abdomen. These figures, although probably rather small, point clearly to the relative safety of exploration through the chest and diaphragm for upper abdominal injuries.

Injuries Present in the Thoraco-Abdominal Cases.

The heavy mortality in this series is explained by the details of visceral injuries found at operation. There were (*a*) four patients with very severe abdominal injuries; (*b*) six patients with severe and one with moderate injury of the liver; (*c*) one patient with injury to the kidney requiring nephrectomy; (*d*) three patients with injury to the spleen requiring splenectomy; (*e*) one patient with fracture of the femur; (*f*) one patient with hemiplegia; (*g*) two patients with retroperitoneal hæmorrhage.

SPECIAL DATA CONCERNING THE TREATMENT OF THE PATIENTS.

Time of Admission to the Operating Unit after Receipt of the Wound.

The time that elapsed between the receipt of the wound and admission to the operating unit has been calculated according to the time of death and

also for the patients who recovered. The uniformity of the average time is remarkable.

When death occurred after 24 hours the time interval was 6·4 hours. When death occurred after 48 hours the time interval was 4·0 hours. When death occurred later in forward areas the time interval was 7·25 hours. The average time interval for all forward deaths was 6·6 hours.

For patients who recovered and were graded A to D the time interval was 6·5 hours. For those who recovered and were graded E the time interval was 6·0 hours.

Time of Operation after Receipt of the Wound.

Again a remarkable uniformity is seen in the time interval between receipt of the wound and operation. In the cases in which death occurred in the forward areas the time interval was 10·4 hours. In the cases in which recovery occurred it was 10·4 hours. Two cases in which operation was performed three days after injury were excluded from the figures.

TABLE I.

Showing Relation of Time of Operation After the Receipt of the Wound to the Death Rate.

Time of Operation.	Total.	Dead.	Percentage Mortality.
Under 12 hours..	79	39	49·3
Over 12 hours	26	18	79·2
On third day	4	2	50·0

This is in keeping with the natural increase in mortality in those patients in the forward areas who have not been collected for some time and so have been subjected to exposure and, maybe, to excessive hæmorrhage.

Time of operation in itself is, of course, only a contributing factor, the essential causation of death being the severity of the injury. There are so many factors to be considered that the rough generalization that late operation causes a heavier mortality is all that can be established. The matter will be discussed later, as, in my opinion, there is danger in thinking that the matter is so important that the patient must be rushed to the operating table before the optimum time for operation has been reached by resuscitatory measures.

Amount of Blood and Plasma given before Operation.

Blood.—Patients who died in the forward areas received an average of three pints of blood; patients who died at the base areas received an average of two pints of blood; patients who lived received an average of 2·3 pints of blood.

Plasma.—Patients who died in the forward areas received an average of 2·1 pints of plasma; patients who lived received an average of 1·7 pints of plasma.

The average patient had usually two pints of blood and one of plasma.

Blood and Plasma after Operation.

There are insufficient figures available to give the complete story of blood and plasma given after operation, but those recorded show that in cases in which death occurred in forward areas an average of 2·5 pints of blood and 1·6 pints of plasma was given.

Condition on Admission to the Operating Centre of Patients Who Died.

The condition on their admission to the operating centre of the patients who died is shown in Table II.

TABLE II.

Time of Death.	Condition of Patient.		
	Very Bad.	Bad.	Fair.
In 24 hours after operation	29	10	3
In 48 hours after operation	4	1	—
Later in forward areas	5	3	1
Total, 56	38 (68%)	14 (25%)	4 (7%)

Condition Immediately before Operation of Patients Who Died.

The condition immediately before operation of the patients who died is shown in Table III.

TABLE III.

Time of Death.	Condition of Patient.		
	Very Bad.	Bad.	Fair.
In 24 hours	27	2	10
In 48 hours	1	—	—
Later in forward areas	2	1	3
Total, 46	30 (65%)	3 (6·5%)	13 (28·5%)

The comparison shows clearly that 65% of the patients whose histories are recorded still remain very bad risks, but that distinct improvement has taken place in many instances before operation. It is obvious, of course, that some improvement took place in nearly all the cases.

Condition after Operation of the Patients Who Died.

The condition after operation of the patients who died is shown in Table IV.

TABLE IV.

Time of Death.	Condition of Patient.		
	Very Bad.	Bad.	Fair.
In 24 hours	23	9	3
In 48 hours	5	1	—
Later in forward areas	2	3	1
Total, 47	30 (64%)	13 (27·6%)	4 (8·4%)

The operation has caused a deterioration in the condition of the patients, as one would expect.

Recovery Following Operation.

In a total of 84 patients studied no less than 28 at no time showed any signs of recovery following operation. Twenty-six of these died in twenty-four hours and one each in the forty-eight hour period and in the later period—practically a third of the deaths. Five of these died on the table and two as soon as they reached the ward.

Extent of Injuries Sustained.

It is possible, from a study of all the particulars gathered both before death and at the post-mortem examination, to evaluate the injuries. A post-mortem examination was carried out after nearly all of the deaths unless it was obvious no further information could be gained. The severity of the injuries is shown in Table V.

TABLE V.

Time of Death.	Type of Injury.			
	Hopeless.	Very Severe.	Severe.	Other.
In 24 hours	19	12	13	2
In 48 hours	—	3	3	—
Later in forward areas ..	4	6	7	—
Total, 69	23 (33·3%)	21 (30%)	23 (33·3%)	2 (3·4%)

Other Severe Wounds Present.

Thirty-three of the patients who died suffered from other severe wounds (33% of the deaths). Of these, 14 died in twenty-four hours, two died in forty-eight hours, nine died later in forward areas and eight died at the base.

Included in those severe injuries were nine fractured femurs, nine cases in which amputation was necessary, seven cases of severe head injury, nine cases of severe spinal injury, and 16 fractures of the ilium.

PRESENCE OF BLOOD, FÆCES AND BILE IN THE PERITONEUM.

Blood.—I have been impressed by the large number of records which show that there has been much blood in the abdomen. They all show clearly that the prognosis in these cases is bad. The extent of the loss of blood is naturally a factor, but, I am sure, not the only factor that determines the bad results. (Very severe hæmorrhage is associated with severe kidney injuries and with damage to the large vessels, both the main trunk vessels and the mesenteric arteries. Severe injury to the liver sometimes produces considerable hæmorrhage, but moderate liver and slight splenic injuries often produce little bleeding, and this bleeding stops readily without any local treatment. Knowledge of this has led to the treatment of the lesser liver injuries without operation.)

In the series of 102 patients who died following operation, 33 had a large quantity of blood in the abdomen and 18 had a moderate quantity. The amount in all cases was sufficient for special mention to be made of it in the notes.

The total percentage is 50, so that half the deaths were associated with at least a moderate amount of blood in the abdomen. Of the 123 patients who

lived, only seven had a record of excessive blood and sixteen of moderate bleeding.

Fæces.—The presence of fæces was noted in ten cases, and all the patients died.

Bile.—The presence of bile is noted in four cases and all the patients died. The bile was associated with severe damage to liver or ducts.

COMPLICATIONS ARISING IN THE CASES IN WHICH DEATH OCCURRED.

The large majority of the deaths was due to the severity of the injury, and the patients never picked up in spite of every effort at resuscitation. The major complication was anuria.

Anuria.

I am quite convinced that anuria is largely a method of death from severe trauma and the so-called toxæmia associated with extensive damage to muscle. There were twelve deaths, one occurring in the forty-eight hour period, and the others later in the forward areas. The time of death following operation was:

Second day	1	
Fourth day	2	8
Fifth day	2	
Sixth day	4	
Eighth day	1	
Tenth day	2	

Two-thirds of the deaths took place from the fourth to the sixth day. The conditions noted in these cases were as follow. A large dose of blood was given in one case only; four patients were extremely shocked; four had a very large quantity of blood in the abdomen; three had fæces and also a fairly large quantity of blood in the abdomen; two had injuries to the main blood vessels of the lower limbs; one had amputation of the thigh; two had large buttock wounds; two had injuries by blast which in itself causes a high mortality; three had multiple abdominal injuries; three had injuries to both the small and large intestines; one had an injury to the pancreas; one had an injury to the duodenum; one had an injury to the liver and gall-bladder.

I think this list makes it evident that anuria was an accompaniment of severe injury. The theory that the renal circulation is shut off in order to preserve the systemic circulation and that, if this anæmia of the kidney lasts long enough, the kidney tubules are inevitably damaged, certainly makes a strong appeal in the light of these records. We have acted accordingly by giving glucose and saline solution intravenously early, in conjunction with blood transfusion, to all badly shocked patients. It appears that only preventive measures are of any avail, as we have had no success in the treatment of the condition when it had become established. The condition is often associated with casts and albuminuria.

Hæmorrhage.

Primary hæmorrhage was noted to be very severe in eight of the 46 cases in which death occurred within twenty-four hours of operation, and bleeding of some severity was present in the large majority of the cases. There is no doubt that loss of blood by itself is a main cause of death in the early stages.

Injury to Main Vessels.—Injury to main vessels occurred in Case XXIV.

The patient was given twelve pints of blood, but died on the table before anything could be done. Post-mortem examination disclosed an enormous quantity of blood in the abdomen from injury to the left internal iliac artery. There were associated injuries of the small and large intestine and bladder.

Bleeding from a Solid Viscus.—Bleeding occurred from the kidney, the liver and the spleen.

Kidney. Severe kidney lacerations, which are not uncommon, can produce severe hæmorrhage, particularly if the hilum is involved. Extensive retroperitoneal bleeding from a ruptured kidney has produced some of the most serious cases.

In Case XXXIII extreme pallor was noted and the blood pressure, which was 60 millimetres of mercury, systolic, and 30 millimetres, diastolic, before operation, could not be raised in spite of blood transfusions. The patient was operated on five hours after he was wounded and a massive retroperitoneal hæmorrhage was found. As soon as the peritoneum over the kidney was opened the patient collapsed and died. At post-mortem examination the kidney was found ruptured through the pedicle.

Liver. Small liver wounds, associated or not with the retention of small foreign bodies, are amongst the least serious of all abdominal wounds, and can, if diagnosed correctly, be treated without abdominal exploration. Large lacerations of the liver, on the other hand, are often associated with a considerable amount of bleeding and cause a rather high mortality partly because those injuries are so often associated with other serious lesions.

Case VII was one of thoraco-abdominal injury. Laparotomy disclosed that the peritoneum was full of blood from a severely damaged liver. Four mattress stitches were inserted and a foreign body was removed from the dome of the liver. The patient did not pick up and died within twenty-four hours.

Normally bleeding from the liver does not require any surgical treatment at operation. By that time bleeding has, almost always, stopped. Stitching or packing is very rarely required.

Spleen. Serious splenic bleeding is not often encountered. Small tears of the spleen can generally be left alone, but, of course, major lacerations demand splenectomy. The removal of the spleen by the thoracic route is easier than it is through the abdomen and causes a much lower mortality. It is our normal routine in thoraco-abdominal cases. I can find no case in which bleeding from the spleen has been the main cause of death.

Injuries to more than one solid viscus. There were 12 cases in which more than one solid viscus was injured, and nine of the patients died. Combined injury of the spleen and kidney provided two of the recoveries.

Bleeding from Mesenteric Vessels.—Severe bleeding often arises from mesenteric vessels and quite often the injury to the vessel may be the only serious injury. The special danger in these cases is the persistence of the bleeding, in contradistinction to the conditions generally found in injuries to a solid viscus.

There were in all 17 patients recorded as suffering from mesenteric injuries. Of these, ten died—a very high mortality. Six of them died in the first twenty-four hours. However, out of eight patients with involvement of only the small intestine and its mesentery six are alive. The recognition of these cases is of supreme importance, as they are just the cases that might be thought to be hopeless, as resuscitation will not occur even with a liberal supply of blood. I have a vivid memory of a classical case as follows.

The casualty was noted at the main dressing station to be in quite good condition some hours after the wound was received. When he arrived at the casualty clearing station he was pulseless and gravely ill. He was given blood, but his condition did not improve very much and the forward transfusion unit officer, a most excellent and experienced man, doubted the patient's ability to stand any operative measures. I made a dogmatic diagnosis of continued bleeding from a mesenteric vessel and counselled immediate operation with blood running. To my mind the diagnosis was obvious, as his condition had been good at the main dressing station and bleeding was the only thing I know of that would rapidly make the condition of a patient with an abdominal injury worse when the primary trauma had not seriously affected him. A large mesenteric vessel, bleeding freely, was found, with minor injury to the small intestine. The patient made a quick recovery.

In another case, before operation and during it seven pints of blood and two of plasma were given. The abdomen was full of blood and arteries at the root of the mesentery were severed. Three holes were present in the small intestine. The patient recovered even though resuture of a rupture of the wound was necessary later.

Retroperitoneal Hæmorrhage.—Retroperitoneal hæmorrhage without an associated intraabdominal injury is a condition of great interest and of not uncommon occurrence. A full record of these cases is not available, as the large majority of the patients had no abdominal injury and are not included in the series of abdominal cases. Only two patients were operated on for retroperitoneal hæmorrhage, and they both recovered. This satisfactory state of affairs is due to our long recognition of the symptomatology of these injuries and their careful diagnosis by clinical and radiological examination. Signs of seeming intraabdominal injury are present, with tenderness and local rigidity. X-ray examination is made to localize the foreign body and so help to determine the track of the missile and to decide whether intra-abdominal injury is probable. The patient is not as ill as a patient with an ordinary abdominal wound, and peristalsis is generally audible. Injuries in the diaphragmatic area also give rise to marked abdominal signs and symptoms, and have to be similarly carefully evaluated. As a worker in the pre-operative ward, I always felt one of my main functions was to save these patients from laparotomy by careful X-ray examination and by watching their progress.

Secondary Hæmorrhage.—I have records of seven patients with secondary hæmorrhage, five of whom died, one at a late period in the forward area and four at the base.

The history of the patient who died in the forward area was exceptional inasmuch as the bleeding occurred into the lumen of the small intestine from a portion of wounded jejunum. Death took place on the eighth day, when survival was hoped for, and was the result of a very severe injury of the caecum and ascending colon, for which the right side of the colon had been removed. There was also an injury of the small intestine.

The deaths at the base were caused as follows. In the first case bleeding occurred from the superior gluteal artery in a large buttock wound. There had been a wound of the pelvirectal junction of the colon, of the small intestine and, later, a urinary fistula. In the second case resection of the ileum was followed by infection, with bursting of the wound, peritonitis, necrosis of the ilium and finally mesenteric bleeding. In the third case a wound of the perineum involved the rectum and prostate. There was also a compound fracture of the femur. Pelvic cellulitis followed, but death was due to hæmorrhage from the external circumflex artery in the thigh. In the fourth case injury to the caecum, small intestine and ureter was present, as well as compound fracture of the tibia and fibula. Partial rupture of the wound took place five days later and then secondary hæmorrhage started. The patient died of severe peritonitis and toxæmia, the injury to the ureter being the determining factor. All four cases were associated with marked sepsis.

The two cases in which the patients survived were both associated with colostomy. In one case hæmorrhage occurred in a colostomy wound; in the other hæmorrhage took place from the mid-colic artery in a colostomy wound.

INTESTINAL OBSTRUCTION.

Nine cases of intestinal obstruction were reported. Six of the patients died, three later in the forward areas and three at the bases.

Deaths in the Forward Area.—The three deaths in the forward area were as follows.

In the first case the patient was transferred from a British casualty clearing station. The jejunum was completely severed and four other holes were present as well as a tear in the superior surface of the third part of the duodenum. Later the stoma in the sutured area became obstructed and entero-anastomosis was carried out without success.

In the second case much blood was present in the peritoneal cavity (about three pints in all). Bleeding occurred from the gastro-epiploic vessels; tears were present in the transverse colon, the jejunum and the posterior wall of the stomach. Colostomy was performed. The patient died of obstruction six days later and a loop of small intestine was found adherent to blood clot in the pelvis. (See note on drainage later.)

In the third case four holes were present in the small intestine; a drain was inserted into the pelvis; ileus was present on the fifth day and the patient died on the seventh day. At post-mortem examination the small intestine was glued together and grossly distended. A small leak from one hole had caused the peritonitis.

Deaths at the Base.—The three deaths at the base were as follows.

In the first case the patient was transferred from a British casualty clearing station. Much blood was present in the abdomen and there were injuries to the liver and transverse colon. Caecostomy was done later for obstructive symptoms. At the post-mortem examination peritonitis and small bowel obstruction were present.

In the second case seven holes were present in the small intestine and there was a wound of the liver. Infection occurred with bursting of the wound and was associated with perforation of the small intestine. Mild obstructive symptoms were present for three weeks. The patient died of toxæmia from generalized peritonitis.

In the third case six holes were present in the small intestine and resection was carried out. The wound became septic and purulent bronchitis developed. Intestinal obstruction was dealt with by ileostomy. At the post-mortem examination gangrene of the lung and peritonitis were present.

Survivals.—Of the patients who survived, one had a volvulus which was relieved at operation. The wound broke down later. In another old adhesions due to a pre-war operation caused obstruction following laparotomy for a gunshot wound.

It can be seen from the cases recorded that obstruction is usually a sequel of peritonitis.

CHEST COMPLICATIONS

Chest complications were surprisingly uncommon as far as serious lesions were concerned. Only seventeen cases were noted, nine patients dying and eight living.

Of the deaths, two occurred in the first twenty-four hours, one patient dying of pulmonary embolism and one of collapse of the lung and pulmonary œdema.

Later, in the forward areas, one patient had pneumonia, one had lobar collapse, one had abscess of the lung and four had some degree of œdema of the lung.

At the base three patients had either abscess of the lung or empyema. One of these had a broncho-hepatic fistula and another gangrene of the lung.

Apart from the obvious septic conditions, lung complications were therefore of little importance. Œdema of the lung was probably a terminal condition and not really a lung lesion at all. It often is the final phase of an anuria.

SEPTIC COMPLICATIONS.

Sepsis is manifested in many different ways, of which frank peritonitis is the most common. The bursting of the abdominal wound is also a frequent manifestation, and, as pointed out by a Royal Army Medical Corps investigation in Italy, sepsis in the wound is practically always associated with deeper sepsis in the abdomen.

Peritonitis.

Peritonitis was noted as a cause of death in 14 cases. One patient died at the casualty clearing station unoperated upon, having been admitted very late in a moribund state. No patients died in the first two days following operation. Four patients died at a later period in the forward areas out of a total of 33 deaths.

In one case there was a moderate quantity of blood in the peritoneum, including a pint in the lesser sac. Two holes were present in the duodenum and bleeding occurred from the pancreas, and retroperitoneal hæmorrhage was present. The abdomen was drained and bile was drained away in fairly large quantity; this pointed to a possible injury of the common bile duct. Deep jaundice developed and a duodenal leak started, with consequent skin digestion. An attempt was made to save the patient by cholecystostomy and jejunostomy, but he died at the completion of the operation.

These cases were not straight-out cases of peritonitis, but in all some other development was present, such as ileus, obstruction, leak from a bladder wound, paraplegia, wound of the rectum.

The majority of the cases occurred at the base, where infection was almost the universal cause of death. In nine cases out of a total of 16 peritoneal infection was the main cause of death.

In one case there were six holes in the small intestine; operation was performed fourteen hours after the patient was wounded. Resection of the bowel was carried out. Intestinal obstruction occurred and ileostomy was performed. The wound broke down and the fæcal fistula continued. Purulent bronchitis developed and eventually gangrene of the lung with multiple lung abscesses occurred. At the post-mortem examination peritonitis and gangrene of the lung were present.

This gives a good example of the widespread infection and was a common story of those dying at the base from failure to resist infection.

In another case there were ten holes in the small intestine and a foreign body was removed from the pelvis. Hæmatoma of the wound formed and the wound became septic and burst. A fæcal fistula developed and localized peritoneal abscesses formed. At the post-mortem examination gangrenous peritonitis was present.

This case is of interest as death took place on the twentieth day and the patient had been evacuated from the casualty clearing station comparatively early. Any chance these infected patients have is seriously jeopardized by the disturbance caused by transfer to another hospital. This lesson has been learnt and relearnt by us.

Abscess Formation: Subphrenic Abscess.

There were three deaths from abscesses noted at the base and two recoveries.

In one case operation was performed in twelve hours; extensive blood was present in the abdomen associated with injury to the liver. No drainage was established. Subphrenic abscess and empyema developed, for which drainage was instituted. The patient died suddenly, probably from cardiac failure associated with the toxæmia.

Naturally the question of drainage arises. This will be discussed later.

In another case a loin incision was made and a shattered kidney was removed; gross laceration of the liver was present and the diaphragm was torn. Drainage was established. Aspiration took place regularly afterwards, but jaundice developed and gross sepsis with a foul subphrenic abscess. Then gangrene of the lung and empyema occurred.

Gangrene of the Bowel.

Gangrene of the bowel is really a vascular rather than a septic phenomenon. There were two cases, one in the forty-eight hour period, and one patient died later in the forward areas.

In the first case there were three pints of blood in the abdomen, coming from mesenteric bleeding, also four holes in the small intestine and two holes in the caecum,

with much laceration. Retroperitoneal hæmorrhage was present, also a small hole in the pelvic colon. A caecostomy was performed and exteriorization of the pelvic colon was carried out. Death took place in twenty-four hours, and at the post-mortem examination the last six inches of the ileum and two-thirds of the ascending colon were becoming gangrenous.

In the second case at least two and a half pints of blood were present in the abdomen, also clots. A huge clot five inches in diameter was present in the lesser omentum, also in the mesocolon. A tear in the diaphragm and also a large wound in the spleen were found. A bridge of gangrenous stomach and foul, free fluid were present. Operation was not carried out for three days after the patient was wounded; then splenectomy and suture of the stomach were undertaken, but the patient died of ileus eighty-four days after he had been wounded. It is wonderful that he lived so long.

Localized Abscesses.

Ten patients had records of abscess; six survived and four died at the base.

In one case injury to the small intestine (multiple holes) and pelvirectal junction of the colon was associated with a large buttock wound with injury to the superior gluteal artery in the great sciatic notch. Colostomy was performed. Urine leaked later from the abdominal wound and a large pelvic abscess developed, communicating with the buttock wound. The patient died rapidly of profuse secondary hæmorrhage in the pelvis.

In the second case the ascending colon and caecum were perforated in several places. Small rupture of the liver had occurred and retroperitoneal hæmorrhage was present. A Paul's tube was inserted and the colon was exteriorized. The wound broke down, secondary hæmorrhage occurred and the buttock wound discharged fæces. The patient died of uræmia and toxæmia and had an abscess in the liver.

In the third case the descending colon was divided and exteriorized. Retroperitoneal hæmorrhage occurred in the psoas region. There was an associated injury to a lumbar vertebra and a fracture of the ilium. A large abscess developed in the psoas region, due to infection of the retroperitoneal hæmorrhage from a small extraperitoneal hole in the ascending colon. The abscess was drained and the hole closed, but the patient died from toxæmia, and at the post-mortem examination peritonitis and pericarditis were both present as well as the infection in the psoas region.

In the fourth case moderate bleeding had occurred in the peritoneum. The small intestine was injured and one large tear had taken place in the extraperitoneal portion of the rectum, which was sutured, and drainage was instituted through the buttock wound. Abscess of the abdominal wound developed on the tenth day. The patient was evacuated on the eleventh day. He also had a compound fracture of the femur. Sepsis developed in the buttock wound and in the femur, and he developed a cerebellar abscess, meningitis and bronchopneumonia. The femur injury was responsible for his evacuation from the casualty clearing station on the tenth day to enable definitive fracture treatment to be instituted at the base hospital, which was quite close, and evacuation was easy. Perhaps the femur should have been ignored.

Burst Wound.

Eleven cases of burst wound were noted with eight deaths, two in the forward areas and six at the base. That means that six out of the sixteen patients who died at the base had infected wounds.

Of those who lived, one had a pelvic abscess, one had had an abdomen full of blood from mesenteric bleeding, and one had acute intestinal obstruction due to a band. In the eight deaths the findings were as follows.

(i) Marked liver damage was present and the patient died of toxæmia on the twelfth day.

(ii) A suprapubic opening was made and colostomy was performed, also the main femoral vessel was ligated. Jaundice developed and then the abdominal wound burst, and finally the patient developed anuria and died on the tenth day.

(iii) The patient died of peritonitis and generalized infection.

(iv) Severe infection was associated with a buttock wound discharging fæces; liver abscess was present.

(v) The patient had an abscess in the peritoneum and also serious knee joint sepsis.

(vi) The patient died of peritonitis from perforation of the small intestine.

(vii) Following resection of the small intestine the patient developed peritonitis and a gangrenous lung. He also had intestinal obstruction.

(viii) There was an infected hæmatoma of the wound which burst, and the patient developed a fæcal fistula and abscesses in the peritoneal cavity.

Besides actual bursting of the wound, wound infection was associated with another death at the base. Another patient had an abscess of the abdominal wound and another had partial rupture of the wound with secondary hæmorrhage.

Half of the patients who died at the base therefore had serious infection of the abdominal wound associated with peritoneal and generalized infection.

OTHER CAUSES OF DEATH.

There was one case of hyperpyrexia, with wounds of the colon and burns. The abdominal injuries were severe and the patient was delirious on arrival at the casualty clearing station. This was a death from burns.

One death within twenty-four hours was ascribed to acute dilatation of the stomach, but the injuries were very severe and included an amputation of the arm, so probably the dilatation was mainly part of the general collapse.

TYPES OF ABDOMINAL INJURIES SUSTAINED.

The multiplicity of the lesions in the abdomen and also the association of wounds elsewhere in the body make it very difficult to classify the cases and evaluate the results. It is impossible to do more than give the main features of the lesions. These are shown in the accompanying tables.

TABLE VI.

Frequency of Injury to Separate Organs, either Single or Combined with other Injuries.

Organ.	Number of Cases.	Number of Deaths.
Small intestine	106	50
Large intestine	98	48
Liver	65	30
Kidney	26	16
Stomach	24	12
Spleen	23	10
Rectum	13	6
Bladder	12	6
Gall-bladder	3	1
Pancreas	4	4
Duodenum	5	3

TABLE VII.

Injuries of Single Organs with or without Extraabdominal Injuries.

Organ.	Number of Cases.	Number of Deaths.
Small intestine	36	10
Large intestine	27	8
Liver	23	11
Spleen	8	2
Kidney	7	2
Rectum	4	1
Stomach	4	0

This table demonstrates very clearly the seriousness of gross liver injury and the satisfactory recovery from stomach injuries.

TABLE VIII.

Injuries of More than one Abdominal Organ.

Organ.	Number of Cases.	Number of Deaths.
Small intestine and colon	34	15
Small intestine and rectum ..	3	1
Small intestine and bladder ..	3	2
Small intestine and liver	3	1
Small intestine, liver and kidney	1	1
Colon and kidney	2	2
Colon and liver	3	3
Colon and spleen	1	0
Stomach and liver	2	0
Stomach and colon	2	0
Stomach and spleen	1	1
Liver and kidney	4	3
Rectum and bladder	1	1
Duodenum and pancreas	1	1
Duodenum and small intestine ..	1	1
Rectum and prostate	1	1
More than two organs	11	5

TABLE IX.

Injuries not Involving a Viscus.[1]

Type of Injury.	Number of Cases.	Number of Deaths.
No viscus injury but some pathology	12	0
Liver injury with retained foreign body but no laparotomy ..	7	0
No intraabdominal injury	8	1
Total	27	1

[1] Including cases with liver injuries with retained foreign bodies and cases of retroperitoneal hæmorrhage, and also of blood in the peritoneal cavity.

In the one case death was due to severe multiple injuries, including a compound fracture of the tibia and fibula, for which an amputation at the thigh was performed. Compound fracture of the radius and ulna, penetrating wounds of leg, arms, neck and penis were present. The patient was badly shocked and died of uræmia and anuria on the sixth day.

It is satisfactory that none other of the 27 patients died, especially as figures quoted at the Rome conference gave a much more gloomy picture. It is also satisfactory to note that in only nine cases was no intraperitoneal lesion of any kind found, in spite of the fact that only 3% of patients with abdominal injuries were not operated on at the casualty clearing station level, and only three patients in our New Zealand unit.

TABLE X.

Operations by Thoracotomy without Laparotomy.

Type of Injury.	Number of Cases.	Number of Deaths.
Involving liver injury	6	1
Involving penetrations of foreign body into liver	2	1
Involving spleen	2	0
Involving peritoneal bleeding ..	1	0
Involving liver and kidney ..	1	0
Total	12	2

ASSOCIATED SEVERE INJURIES.

As every forward surgeon knows, multiple injuries lead to much anxiety, and if any of the injuries are severe the patient's chance of recovery is much diminished.

Examples of injuries noted are as follows.

Amputations.—Out of six patients subjected to amputation only one survived, and this was after an arm amputation. Only one thigh amputation was noted in the series. Three patients died without operation.

Fracture of the Femur.—Out of six patients with fracture of the femur two survived. Three patients died without operation.

Severe Head Injuries.—Out of six patients with severe head injuries two survived. Two of the patients died definitely from the head and not from the abdominal injury. One patient died (B.I.D.).

Spinal Injuries.—Out of seven patients with spinal injuries three survived. Of the four who died, two had complete paraplegia and two *cauda equina* injury. The fate of the two surviving patients with paraplegia is naturally not settled, but as far as the abdominal condition was concerned full recovery had taken place before evacuation to New Zealand. Two patients died without operation.

Fracture of the Ilium.—Fifteen patients with fracture of the ilium were reported, seven surviving. One died without operation.

It can be seen that associated severe injuries were present in a large proportion of those who died without being submitted to operation, and that amongst those operated on the mortality was still very high.

FOREIGN BODIES IN THE PERITONEAL CAVITY.

In 42 of the cases the foreign body was removed at the primary operation and ten of the patients died. Two foreign bodies were removed later, when the patients had recovered.

THE PLACING OF THE FORWARD OPERATING CENTRE.

There are two, sometimes conflicting, ideas on the subject of the placing of the forward operating centre. One is that the centre should be as far forward as it is humanly possible to place it, so as to save prolonged evacuation of the patient and so diminish the natural exhaustion. The other is that the centre should be reasonably far away from military hazards and noise, where the maximum efficiency as regards equipment and staffing can be guaranteed and easy evacuation can be assured. In my opinion the solution must take into account both these factors and, of the two, I consider the second one the more important. Our force has probably done more operating in the field ambulances than any other in the British Army, and we have had excellent results, especially in the desert campaigns. We were blessed with some capable and energetic young surgeons, and a high standard of efficiency was gained by our nursing orderlies. We had special equipment in the field ambulances and attached surgical teams and transfusion units. The equipment and the nursing were never, however, quite as good as at the casualty clearing station, and the casualty clearing station is a more stabilized unit. A few abdominal casualties can hamstring a field ambulance, as in these cases the patients should not be shifted after operation for at least ten days, and frequently very much longer. The field ambulance has no X-ray plant and has no nursing sisters. It generally has not so large a surgical staff as the casualty clearing station, and spelling of the teams is more difficult.

The casualty clearing station, to my mind, should be as far forward as possible, just out of danger and away from too much noise—the closest place

where the nursing sisters could be put. Then probably in most circumstances there should arise no difficulty in deciding that the patients with abdominal wounds should go to the casualty clearing station. Again, we have gradually altered our ideas as regards priority. Now, besides patients with hæmorrhage and traumatic amputations, those with severe limb injuries and sucking chests have priority. It is recognized that there is danger of operating too quickly on the ordinary severely shocked patient with an abdominal wound; therefore, there is not the urge there used to be to operate in the ambulances.

If the ambulance is to be used as the forward operating centre it must be properly staffed and equipped. Particularly it must have attached to it sufficient surgical teams to be able to spell the staff regularly and adequately, especially the orderlies. The old practice of one surgical team undertaking all the responsibility of operating at a forward centre and carrying on till all its members dropped of fatigue should never happen again. It was dreadful for the staff and also for the patients. The ideal set-up is for three casualty clearing stations to be grouped as a forward operating centre and for the patients to be directed to them in rotation by a sorting unit near by. This worked well and with the utmost efficiency in the desert campaigns and has been the practice in Italy. The special patients with injuries to the head, the facio-maxillary region and the eyes can be sidetracked to a special unit close to the forward operating centre, which would mother the special teams involved and, at the same time, provide the more ordinary surgical teams to do the non-specialist surgery.

EQUIPMENT OF A FORWARD OPERATING CENTRE.

The special equipment necessary consists of: (*a*) an X-ray plant and two technicians; (*b*) an electric lighting plant for every forward surgical unit, with some kind of standard lamp; (*c*) a suction apparatus, preferably simple and foolproof; (*d*) a high-pressure sterilizer.

As far as surgical instruments are concerned, the most useful are large mastoid retractors, simple abdominal retractors, and some good long clamps, especially a good kidney pedicle clamp. A rib spreader for use in thoracotomy is essential.

Staffing.

As far as staff is concerned, a forward operating unit should have:

1. The minimum of two surgical units, and preferably at least three, so that proper spelling can be carried out. The forward surgical units consist of a surgeon, an anæsthetist and five other ranks. The American units have a junior surgeon added to the team, which would be a great advantage if staff was available. A fully trained anæsthetist can be of the utmost value, as our casualty clearing stations realized in Italy when they had the assistance of a senior Royal Army Medical Corps anæsthetist. One senior anæsthetist in each group of field surgical units is of the greatest value both to give the anæsthetics in difficult cases and, especially, to be available for advice and training.

2. A forward transfusion unit with preferably two medical officers. The single forward transfusion unit officer in times of rush gets no rest and is very much overworked. A relief should be available, both to spell the regular officer and to give to another officer the invaluable training that this work supplies.

3. Pre-operation ward. The officer in charge of this ward is frequently the forward transfusion unit officer, and if he has had good surgical experience he is able to carry out the work satisfactorily. Otherwise, one of the

general duties officers is frequently put in charge, and in other units members of the surgical teams are utilized in rotation.

I feel strongly that for the utmost efficiency a senior surgeon with both civil and military experience would be invaluable in the handling of patients in the pre-operation ward, and also for observation of the seriously wounded patients in the post-operative stage in cooperation with the individual surgeons of the forward surgical units. In our casualty clearing station the officer in command of the unit has always been a man of this type, and I myself acted in that capacity during the Alamein battle and the Tunisian campaign. The diagnosis of the abdominal condition, and particularly the optimum time for, and the priority of, operation call for mature knowledge and judgement.

4. Care of cases in the wards after operation. The normal method is for post-operative care to be carried out by the surgeon who has operated on the patient. Although this throws an extra burden on an overworked officer, I feel that nobody can do the work so well or with the same enthusiasm, and I think this should be the regular routine. In some units general duties officers entirely control the ward management. I consider this inadvisable, except from the administrative point of view—a minor matter where the life of these dangerously ill patients is concerned.

The perfect way is for the senior surgeon referred to under section 3 to be available as a working consultant, attending to the patients and to the evacuation of the patients when the operating surgeons are not available, and advising and cooperating with them, but not taking away from them the responsibility for their own patients.

5. A physician. A physician is invaluable in a casualty clearing station, especially in regard to the treatment of the patients with chest injuries. His different outlook is useful and stimulating to the surgical staff, and he can take over the after-treatment of the chest patients with benefit to everybody.

6. Nursing. Trained nurses should be utilized in the forward operating centres when the operational position is satisfactory. Trained orderlies have done wonderful work in our field ambulances and some have become almost as efficient as nurses, but nevertheless the benefit of nursing training and experience should be made available to these seriously ill patients. Nurses can be trained satisfactorily as junior anæsthetists if the supply of medical officers is inadequate.

RESUSCITATION.

We started this war with the principles of primary pre-operative treatment: (*a*) rest, (*b*) warmth, and (*c*) fluid. We end the European war with the stress on (*c*), with the retention of (*a*) and with discarding of (*b*) except in a minor degree.

Rest.—As regards rest, it implies as little disturbance as possible after the infliction of the wound. It implies also well-regulated evacuation to a forward operating centre, as far forward as is compatible with the provision of full facilities for treatment and for rest itself. It further implies the administration of morphine, and the adequate and immediate splintage of fractures and gross limb injuries. As regards morphine, there is a definite danger of overdosage, especially if large doses of half a grain are administered, and arrangements must be made for the foolproof noting of the doses of morphine.

Rest also implies the retention of the patient on the one stretcher right through the evacuation onto the operating table, and also gentle and trained handling by the orderlies in removing his soiled clothing, cleansing his body and preparing the wounded areas for operation. The work of these orderlies

is of the utmost importance and it is a very pleasing sight to see a really first-class man handling a serious casualty.

Warmth.—It has been proved that overheating is deleterious and one knows that the heating by stoves under stretchers can be extremely dangerous and cause burns in patients with poor circulation. It has even been suggested that refrigeration is the ideal method of treatment for the badly injured patient. In the meantime we can only use our common sense and warm, by simple measures, those patients who are cold and exhausted.

Fluid.—Everybody agrees that the utilization in adequate degree of blood transfusions has been our sheet anchor in the resuscitation of the seriously wounded men. There is argument as to whether plasma is as useful, but though theoretically it might be, the forward surgeon generally is in no doubt as to his opinion on the subject. He relies on blood every time in the forward areas, and unless stale blood is used, there seems to be very little in the way of bad reactions, and at times many pints have been given with success. As pointed out before, blood is not responsible for our cases of anuria. We have utilized blood in our field ambulances from the early days in the desert, and we give plasma even in our regimental aid posts. No doubt plasma can be utilized to take the place of blood in the ambulances, and also a mixture of blood and plasma works very satisfactorily in the ordinary case. If there has been little bleeding, plasma alone may be all that is required. However, we know from Lieutenant-Colonel Grant that four pints is an average loss of blood in severe limb injuries, and he recommends adequate replacement by blood. In abdominal injuries he considers that plasma may be sufficient, as blood loss is not so marked. Our records, however, show that blood is found in the peritoneum in large quantities in a considerable percentage of the serious cases, and that the mortality in these cases is very high. I feel, therefore, that blood must be given in quantities of at least two pints in the serious abdominal cases. In the occasional cases of severe bleeding, as from a kidney pedicle, or from continued bleeding from a mesenteric artery, quite large quantities need to be given. Our average dose of blood to the patients who died was three pints and to those who lived two pints. Our average dose of plasma was about two pints. I think that average is satisfactory and it reflects, of course, the opinion of the forward transfusion unit officers—a knowledgeable group of men.

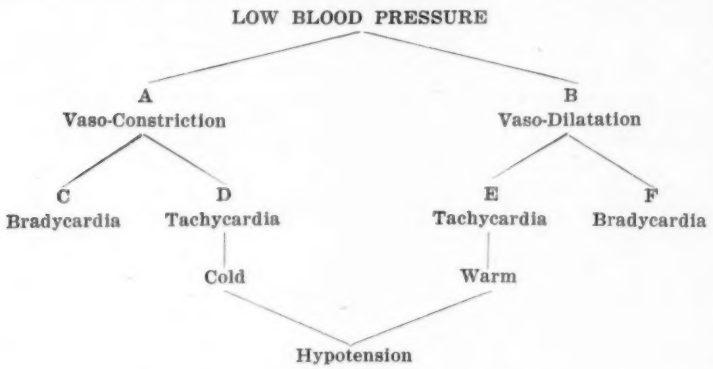
In regard to glucose and saline solution, I am convinced that for the seriously injured men the early intravenous administration of fluid is highly desirable. This is both to combat the dehydration, which is practically universally present, and to attempt to prevent the development of anuria. This is on the supposition that anuria may be due to the protective closure of the renal circulation in order to preserve the systemic circulation. The provision of extra fluid would also, by raising the fluid content of the blood, tend to produce more urinary secretion. Our records show quite clearly that our anuria patients were all very seriously wounded, generally with multiple limb wounds as well. For patients with wounds of the abdomen also there is not the same facility of giving fluid by the mouth—the natural method of combating dehydration.

POST-OPERATIVE TREATMENT OF THE ABDOMEN.

Immediate General Treatment.[1]

In the post-operative state disturbance of circulation is more frequent than it is before operation. Blood pressure is the best index we have, but it is not to be taken as the only indication.

[1] The notes in this sub-section are from a paper read at the Rome conference by Lieutenant-Colonel R. T. Grant, Royal Army Medical Corps.



Vaso-constriction gives thin pulse, small veins, cold extremities, and pallor of face. Vaso-dilatation gives warm extremities, wide veins, face may be flushed, and patients look well.

Cold Type: Before operation the cold type means loss of blood; after operation it means not definitely blood loss, but low blood volume. This generally passes off in two to four hours. Blood loss is often much greater before operation than is suspected, and fluid given soon goes from the circulation. Before operation we can restore the circulation, but not the blood volume. The blood supply to the organs is poor, and this needs treatment. In some cases the causation is uncertain.

Warm Type: The warm type with hypotension is uncommon before, but common after operation. The systolic blood pressure may be only 50 millimetres of mercury. The pulse rate may be 140 to 160. Blood volume is low in many cases. There is some factor causing dilatation of the vessels, and this is favoured by (*a*) warm surroundings, (*b*) ether, (*c*) warm bed, (*d*) warm climate. The action of ether generally passes off in two hours. The cause of the condition is unknown. It may be due to a toxin from muscle.

Treatment consists in (*a*) transfusion, but may not clear up the condition; (*b*) the use of vaso-constrictors, but these have short action. The stage lasts from thirty-six to forty-eight hours. The vaso-dilatation is present all over the body, and affects all organs, including the kidney.

The immediate post-operative condition, which is noted to be very serious in the majority of abdominal casualties, demands the continued observation and treatment of the transfusion officer, and further blood and plasma administration is essential in a large number of cases.

Post-Operative Treatment of the Abdominal Condition.

Post-operative treatment has become more or less stereotyped and has reached a high degree of efficiency.

Position: It has been the established practice to place the patient in the Fowler position as soon as he has recovered consciousness after the operation. Latterly many surgeons have used the flat position for the first forty-eight hours, in order to prevent lung complications, and have then changed to Fowler's position. The latter routine has been adopted by us in the last few months and seems to be quite satisfactory.

Gastric Suction: Gastric suction is introduced as soon as the patient is conscious, or sometimes in the theatre. It is carried out by using the blood set with the thicker tubing provided by the set in place of the smaller Ryle's

tube. It is continued till the danger of ileus has passed and some signs of peristalsis are present. If fluid is given by the mouth while the suction apparatus is in place, the patient will receive some fluid in that way and will have the satisfaction of drinking and moistening his mouth. Easily assimilated fluid nourishment is also now given in the ordinary case with seeming benefit, though we have insufficient experience to dogmatize on the subject. While the gastric suction is being utilized, intravenous administration of saline solution is necessary and retention of chloride does not occur. When suction is discontinued fluid given intravenously should contain glucose.

Suction should not be continued longer than is necessary, as it naturally leads to depletion of body fluid and of gastric secretion and chlorides. In the normal case the patient needs suction for forty-eight to seventy-two hours and in the serious case often for much longer. If distension and other signs of threatened ileus are present, suction must be continued. Established ileus is such a deadly complication that every effort must be made to prevent it. The pathology is simple. Ileus is a symptom of peritonitis which is usually present in lesser or greater degree in all laparotomies. While present, peritonitis automatically leads to intestinal paresis and the absence of peristaltic movements. While this action is present overloading of the small intestine should be prevented by cessation of feeding by the mouth and by suction of the fluid content of the stomach and duodenum, as the small bowel distension itself will aggravate the intestinal paresis. As soon as peristalsis is resumed, fluid can then be given by mouth and suction discontinued. Peristalsis is shown by the passage of flatus or bowel content, and especially by borborygmi. Medicine generally depends on simple observations and the knowledge when to make them. Some surgeons consider that suction is not required in many cases, especially when the colon is involved. My reaction is against this practice, and to institute suction in every case, yes, even in the pucka appendix, and to discontinue it early in appropriate cases.

Intravenous Administration of Fluid: The intravenous administration of fluid is a natural sequel to the non-administration of fluid by the mouth and the institution of gastric suction. As already mentioned, if gastric suction is in action, saline solution is necessary to make up for loss of chlorides. If no suction is used, then glucose solution is the logical answer. Glucose is required either during suction or not, both for its food value and in order to make an isotonic solution. There is no danger of waterlogging the lung with its use. At least eight pints of fluid are necessary over twenty-four hours in the ordinary cases. Naturally, fluid given by mouth and easily assimilated food, especially proteins, should be substituted for fluid given intravenously.

Sulphonamides Given Intravenously: Through the use of penicillin intravenous treatment with the sulphonamides has become unnecessary.

Bowel Action: Purgatives are, in my opinion, distinctly contraindicated in the treatment of an acute abdominal condition. Enemata given later are of value, especially when definite peristalsis is present and when the lower bowel is loaded. Loading of the rectum and lower part of the colon is a common condition in all wounded patients, and one responsible for much discomfort and distress.

Penicillin: I am strongly of the opinion that the use of penicillin as a preventive of infection is a natural measure to adopt. It was given by the Twelfth Army group on the Continent and has been given by us for at least six months. I have already noted that there has not been a single death at the base during the last eight months in our series. All deaths at the base

are due to infection, and there seems a strong possibility that the giving of penicillin has contributed to our results.

Sulphonamides: The introduction of sulphadiazine into the peritoneum at the end of the operation seemed to have favourable and no deleterious results, but with penicillin it may not be worth while, though, of course, the action of the two agents is not similar.

Lung Complications: The adoption of the horizontal position for the first forty-eight hours is held to prevent collection of bronchial secretion and basal congestion. Lobar collapse is held to be due to obstruction by secretion. Penicillin may discourage infection. In any case, in our series, lung complications have been rare. Pulmonary œdema has been seen as a terminal phase in our uræmic and anuric cases.

Bed Sores: Bed sores are an ever-present source of worry in the seriously ill patients, even in the absence of paraplegia. There seems no sure means of prevention. Constant nursing attention and change of points of pressure are natural preventives. In later stages the raising of the foot of the bed and the throwing of the weight onto the shoulders may be of help.

Morphine: I belong to the school that sees nothing but good in moderate dosage of morphine, and, if indicated, the addition of atropine.

THE OPTIMUM TIME FOR OPERATION.

I would have, as already stated, an experienced surgeon diagnose the patient's abdominal injury and collaborate with the forward transfusion unit officer as to the best time to send the patient to the theatre. The forward transfusion unit officer will generally be the one to fix the time according to the amount of blood and plasma that he thinks is required. For estimating the condition of the patient there are several factors to be considered.

The Normal Seriously Injured Man.—In estimating the condition of the normal seriously injured man one has to form a general idea of his appearance and his vitality and then one has to make particular observations regarding his circulation.

The description of the types of circulatory collapse as stated by Lieutenant-Colonel Grant and set out under "Post-Operative Treatment", applies also to the pre-operative state. The two types, cold and warm, are met with, though the cold type is much more in evidence. The three cardinal signs of the necessity for blood transfusion to resuscitate the patient before operation are (*a*) pallor, (*b*) rapid pulse, (*c*) low blood pressure.

In the cold type there will be contracted veins and cold extremities; in the warm type, full veins and warm extremities, but in both there will be the rapid pulse and the low blood pressure. If pallor is present, loss of blood is naturally strongly indicated. Apart from the three cardinal signs, there is the question of the general vitality of the patient, which is a personal matter of the individual. This vitality is often shown by an alertness and a stubborn desire to live. If this is present there is always hope, and some almost incredible recoveries have taken place with this type of patient. The converse also holds in the defeatist type. As the blood pressure is the only definite standard available, a certain numerical basis is generally utilized as a test for the suitability of the patient for operative treatment. A systolic pressure of 100 millimetres of mercury is generally aimed at with a diastolic pressure of comparable degree. The figures are, however, not rigidly applied, but they do give the forward transfusion unit officer something concrete to go on, though the more experienced he is, the less is he forced to depend on the blood pressure reading by itself.

The diagnosis of the nature and severity of the wounds is an essential in the estimation of the patient's condition, and that is why I insist that a surgeon of experience should be utilized in the pre-operation ward. Rule-of-thumb methods dependent on blood pressure readings will lead to frequent disasters. Clinical judgement, in spite of the derision of young men trained to look upon laboratory tests as the final word in medicine, must always remain an important factor. The surgeon must treat the laboratory as his slave, albeit a very useful and generally dependable one.

If the patients appear to have vitality and their blood pressure is rising and is over 100 millimetres of mercury, systolic, and if they have had a period of rest after their journey, then they should be fit for operation. Once that decision is reached, as in all surgical practice, no further time should be lost as the patient tends to deteriorate. He cannot resuscitate him a second time with the same facility. There is not, however, the same restless urge now, as there was previously, to cut down to a minimum the time lag between injury and operation. If it is realized that the patient is improving in condition with a short period of rest and transfusion, an extra hour will not destroy, but improve, his chance of recovery. However, if resuscitation is failing to make an impression on him, and he may possibly be deteriorating, his condition must be summed up quickly, and if there is the least chance of recovery, he must be sent for operation, preferably after prior discussion with the operating surgeon. Massive injury to muscle, traumatic amputation, and also continued mesenteric bleeding, are examples of conditions preventing resuscitation.

The Hæmorrhaging Patient.—The hæmorrhaging patient is exemplified by the patient with a bleeding mesenteric vessel already described. If blood pressure readings had been allowed to make a decision regarding operation he would have died. If one judges rightly that bleeding is taking place, then time must not be wasted in the pre-operation room. I have pointed out in my figures how common serious bleeding is in the abdomen and to what a relatively high mortality it gives rise.

The Very Late Patient.—Occasionally abdominal casualties are brought in after lying out for as much as forty-eight hours or more. At this stage, naturally, if perforation of a hollow viscus has taken place, the peritoneal infection would be localized and probably ileus would be present. These patients must be subjected to the very minimal surgery and simple drainage instituted. They will not stand an extensive laparotomy. If a knuckle of bowel is protruding, drain it until the acute process is over. If a fæcal fistula is present, leave it to drain. Sometimes the patient recovers in a remarkable way without any operative treatment. In any case, he just will not stand an ordinary laparotomy. Late appendicitis is a comparison in civil surgery.

THE OPERATION.

Anæsthesia.

The majority of the patients have anæsthesia induced by "Pentothal" and the anæsthesia continued with ether. If cyclopropane is available it will be the ideal anæsthetic agent.

The Incision.

Two types of incision are usually employed—the longitudinal and the transverse or oblique.

The straight longitudinal incision is paramedian, passes through the rectus muscle, or is in the mid-line. There is a growing preference for the simple mid-line incision, as with its use it is quicker to open and shut the abdomen and there is less bleeding. There seems to be no more liability

to wound trouble, and bursting of the wound is a sequel to infection and not to any special incision. These incisions are the most suitable for a complete abdominal exploration.

The transverse or oblique lateral incision is used either to extend the original wound or for exploration of localized abdominal injuries—those of kidneys, spleen, liver, or sometimes ascending and descending colon. In appropriate cases this type of incision gives less trauma and better local access, and also provides, if required, drainage or a good site for a colostomy. Transrectus incisions are not recommended.

Exploration of the Abdomen.

I am a firm believer in the value of preliminary decision as to the extent and location of the abdominal injuries, and also in the value of X-ray demonstration of the site of the retained foreign body or body injury. I consider that proper prior evaluation will often save a great deal of unnecessary abdominal exploration in desperate cases. It is generally necessary to inspect the small intestine methodically and gently, as multiple perforations are so common and a missed perforation may bring disaster. Most of the other contents are relatively fixed in position and the possibility of their injury is much more easily eliminated. Gentle exploration with the hand and looking into the abdomen with a standard or other light is not traumatizing, but the thorough examination of the large intestine is not so easy a matter. The mobilization of the splenic flexture, for instance, has been stated by some of the forward surgeons to be easy, rapid, and of little consequence. I disagree with this view. I consider that it is a traumatizing procedure, especially from a mid-line incision. It should be carried out only if necessary and certainly not as part of routine abdominal examination; it should be carried out only if it is adjudged that one or other flexure has been injured. The procedure opens up a large raw area for probable infection. These patients are desperately ill and operation necessarily increases the trauma so that every fresh operative manipulation must, if possible, be eliminated. This is what is called surgical judgement—namely, the accurate estimation as to what a patient will stand.

Suction.

The removal of abdominal peritoneal content I consider most necessary, and a good suction apparatus will do this with the minimal trauma. We have had patients who have died as a sequel to retained blood, especially in the pelvis. All our patients with fæcal contamination died and bile also seemed to be badly tolerated. In these cases, therefore, suck out the contents and then drain the pelvis or the loin, or both, for forty-eight hours.

Drainage.

Drainage should be instituted, as stated, for collections in the peritoneum, for liver and kidney injuries, for peritoneal infection and in all doubtful cases.

TREATMENT OF INJURIES.

The Liver.

Fortunately, bleeding from the liver stops automatically, except in rare cases in which stitching, omental damming, or even sometimes gauze plugging may be necessary. In the ordinary case nothing is needed except to empty the blood out of the peritoneum. If the liver damage is severe, a drain to Morrison's pouch for a short period is desirable.

The Spleen.

Injuries of the spleen, such as small tears, also stop bleeding and need no treatment. Occasionally a couple of stitches in the capsule are required. Major injuries demand splenectomy. In thoraco-abdominal cases the spleen is more readily removed through the diaphragm and the mortality is lower.

The Kidney.

Severe injuries to the kidney carry a heavy mortality and severe bleeding is often present; nephrectomy is indicated in those cases. The association of injury to the colon is of great importance, and if there is any doubt about the question of removal of the kidney, the association of injury to the colon would settle the argument. I have seen more than one late death from infection of the kidney in such cases, and have learnt to dread the association. Less serious injuries, however, do not indicate removal and their prognosis is good. This is in keeping with the traumatic peacetime injuries, which we have learned to treat expectantly. Exposure is generally by the lumbar route, but the abdominal route is satisfactory and in recorded cases patients have done well.

The Small Intestine.

The whole of the small bowel should be inspected and the holes marked before any suturing is done. Then the holes should be sutured quickly and simply, generally with a one-layer stitch. If the bowel has not had its mesenteric blood supply interfered with and is quite viable, then simple stitching of multiple holes is the accepted routine. If the blood supply has been interfered with, resection is inevitable. Sometimes a section of the intestine is torn to pieces and must be resected. The mortality in cases of resection has not been so high as one would expect. Out of nine patients subjected to resection only three died. This result gives confidence to the surgeon and prevents his leaving alone a doubtful piece of intestine.

The Mesentery.

As every civil surgeon knows, the mesentery is a troublesome tissue to handle, especially when it is infiltrated with blood. Ogilvie has soundly advised that bleeding should be dealt with by careful thread ligation of the actual bleeding points and not by sutures or by catgut ligatures. The viability of the intestine must be carefully observed after any injury and especially after mesenteric bleeding has been controlled.

The Colon.

It is in the treatment of colonic injuries that difference of opinion arises, and stability has not yet been reached. The success in treatment by the institution of exteriorization of all colonic injuries has been such that it must in the meanwhile be accepted as the best treatment for all marked lesions of the colon, except the caecum, the lower part of the ascending colon and the lower part of the pelvic colon. The formation of a satisfactory spur to the colostomy renders subsequent closure safer and easier, so should be the regular procedure. If bruising and swelling of the colon are present, exteriorization is specially indicated. There are, of course, many lesser injuries of the colon, especially tears through all the coats except the mucous membrane, and also very small holes with no injury to the adjoining colon, which can be dealt with by suture and, if thought fit, especially in retro-peritoneal injuries, by drainage to the site of the injury. One's reaction would

be to use a stitch in the minor injuries and to exteriorize the bowel whenever the slightest doubt arose.

Caecal Injuries.

There are many who advocate treatment of the caecum as if it were a part of the small intestine. Its contents are fluid and drainage is unsatisfactory and troublesome and associated with frequent wound infection. The minor wounds could, I feel, be safely sutured as in the rest of the colon, but the ordinary wound must be drained temporarily, and for this Paul's tube seems to be the logical thing to use, associated with marsupialization by suturing the peritoneum to the bowel.

The grosser injuries with much bruising and circulatory disturbances are, I think, the most difficult of all colon injuries to deal with. I have seen exteriorization of a large mass of caecum and ascending colon with the ileo-caecal valve protruding, marked loss of fluid irritating the skin, and infection of the wound extending into the loin. Partial closure was attempted a few days later, but without success. Resection of the right colon has been advocated, but the results seem conflicting. Some surgeons in forward areas state that the mortality is very high. Ileo-transverse colostomy has been performed without excision of the colon; but naturally this leaves the problem of the excluded colon to be dealt with later. If the colon could be readily excised at the same time, the future would be more certain, but as these patients are generally very seriously ill, a major procedure may be inadvisable. In a serious case the short-circuiting may be an excellent method to adopt and, if we follow civil practice, combined with division of the terminal part of the ileum. I do not think anyone can dogmatize in the meantime, but the exteriorization of a mass of caecum and ascending colon should be prevented some way or another. Also a freely discharging ileo-caecal valve must not be allowed to protrude. Early closure of caecal injuries is also indicated and gives excellent results. Dehydration is thereby prevented. Infection of the abdominal wall must be expected in many cases and drainage provided for, either at the original operation or later, as deemed advisable. Wounds of the lower part of the pelvic colon can be treated only by suture and a colostomy higher up in the colon—normally in the iliac colon, but sometimes in the transverse colon. If the retroperitoneal portion of the colon is involved, drainage of the retroperitoneal tissue is required.

In seven of our cases the colon was oversewn with success—two patients had caecostomies and three had bruising of the colon associated with other injuries. Nine patients with injury to the caecum died, though in only two cases were the injuries uncomplicated by other abdominal injuries. The cases in themselves are not numerous enough and the results are not clear enough to give any lead on the question of treatment. So many patients died early from the severity of the trauma and others died more from associated injuries that, as so often happens in these cases, one cannot satisfactorily compare the results of different methods of treatment. All that one can give are thoughts and impressions.

There has been a recent difference of opinion regarding treatment of the fixed loop colon, especially the splenic flexure area. I agree with the school that considers that mobilization of the fixed colon is not to be lightly undertaken in these serious cases—cases that carry an immediate mortality of nearly 50% from the severity of the trauma. However, in all but one of our cases exteriorization has been carried out and our results are reasonably good.

In one instance a transverse colostomy was performed for a lesion of the splenic flexures, after suture of the hole in the bowel. The patient made an

uninterrupted recovery. Some surgeons in forward areas recommend this procedure and state that they have had great success in its performance. I consider that in certain cases unassociated with severe damage to the bowel it might be done, but if the vitality of the bowel wall is in question, as it always is in severe injuries, exteriorization must be carried out. One awaits the results of the procedure with interest.

The Rectum.

Injuries to the rectum are relatively common, and we record fifteen of them with seven deaths. The lesions are generally associated with wounds of the pelvis, especially penetrating wounds of the buttock and perineum. They can readily be overlooked. Examination of the rectum by the finger will give the clue either by feeling the tear or by the pressure of blood in the bowel. Treatment consists of colostomy and efficient drainage. Drainage is obtained by opening up the pre-sacral space freely. Coccygectomy is carried out to give better access and better drainage.

American observers have stated that necrosis of bone follows coccygectomy and they prefer free lateral drainage; but we have not been worried with the complication and so prefer to keep to what has proved a very satisfactory routine. Severe infection is a natural sequel, with liability to spreading cellulitis in the retroperitoneal tissues. I have a vivid memory of dealing more than once with severe secondary hæmorrhage, in one case, from the origin of the gluteal artery in grossly infected tissues surrounding a large rent in the rectum. Eventually ligature of the vessel as it lay on the spine of ischium controlled the bleeding. The patient survived because he was a very young and stubborn Scotsman. Only one patient in our five uncomplicated cases died. Naturally we shall continue our routine treatment.

The Stomach.

Results of suture of the stomach are extremely satisfactory. The quality of the stomach wall gives rise to excellent healing. If soiling has been severe, the pelvis would be drained as in ordinary stomach perforations; but this is unusual.

The Duodenum.

I have been pleased to see that we have had two recoveries in a series of five cases of duodenal injury. This, nevertheless, is an extremely serious injury, and I should think we have been lucky. The wall is thin and the exposure is at times difficult, and leakage is very apt to occur. Suture and provision of adequate drainage are our routine.

The Bladder.

Treatment of bladder wounds is by suture and the institution of suprapubic drainage. Drainage of the perivesical tissues, especially of the cave of Retzius, is sometimes necessary. Suprapubic cystotomy is also required for injuries of the prostate and urethra. The results of uncomplicated bladder injuries are good; but, as there is usually some other injury, especially to the rectum, there has been a mortality of 50% in our fourteen cases of bladder injury. The combination of a colostomy and a suprapubic cystostomy is not pleasant, but can hardly be avoided. Bladder injury is naturally recognized by the routine procedure of catheterization in all abdominal and possible abdominal injuries.

Retroperitoneal Hæmorrhage.

Retroperitoneal hæmorrhage is a fairly common lesion and one requiring care in the exclusion of intraabdominal injuries. Peritoneal irritation and the signs and symptoms of local peritoneal injury are often present. Careful evaluation of the track of the missile, X-ray demonstration of the localization of the foreign body, and auscultation of the abdomen to hear the welcome peristaltic sounds will permit one to rule out laparotomy. Hæmaturia will often point to a kidney lesion as responsible for the bleeding and the symptoms. Finally, local exploration of the wound will demonstrate that the peritoneum is not involved and will possibly expose a lesion of the extra-peritoneal colon, which may be present. Drainage is generally required following exploration. As mentioned before, minor renal injuries can be treated expectantly.

Diaphragmatic Injuries.

Diaphragmatic injuries again produce signs and symptoms which seem characteristic of intraabdominal injury. However, it is necessary to carry out the same diagnostic routine as in retroperitoneal hæmorrhage and to save the patient the danger of an unnecessary laparotomy. Peristalsis again will be of great value, as so clearly pointed out by Major Rob at Rome.

Association of General with Abdominal Injuries.

The sequence of operative attack requires experience and judgement in the surgeon. The patients are generally very ill and only necessary procedures in regard to other injuries should be carried out. Any operation that requires other than a recumbent position must, if required, be done first, so as not to require the patient to be moved after laparotomy. If bleeding is taking place from a limb injury it should be attended to first. If there is present a traumatic amputation, I should attend to that first, as until it is dealt with it will be responsible for the toxic influence that prevents quick recovery of the patient. Other injuries which can be dealt with readily with the patient in the recumbent position should be left till after the laparotomy so that, if the patient should collapse, they could be left alone. It is often of great value to have two surgeons working at the same time on different lesions to cut down the operating time. The association of head injuries is naturally difficult to deal with. If the patient cannot be safely evacuated to the "head unit" for combined operation, then abdominal operation must be carried out and the head wound dealt with by excision of the wound to prevent sepsis, and such other treatment as is deemed necessary at the time. This will vary according to the experience in head surgery of the operating surgeon. Fortunately the treatment of head wounds of lesser severity is not an urgent problem.

Thoraco-Abdominal Injuries.

It is agreed that if the major wound is in the thorax the thoracic approach is best suited to the associated upper abdominal injuries and that it carries a definitely lower mortality. Exposure of the diaphragm is excellent. Splenectomy can be easily carried out, as can the inspection of the stomach and colon. Suture of the diaphragm is also easy, and crushing the phrenic nerve will make the procedure still easier. The thoracic wound is closed, especially if there is an associated laparotomy. Drainage is not used, but penicillin is introduced at the operation and later. Serious injuries to the liver are, I think, the most difficult cases to handle, and carry a heavy mortality. I think drainage through a high loin incision is desirable in these cases.

EVACUATION OF CASUALTIES FROM CASUALTY CLEARING STATION OR FORWARD OPERATING UNIT.

A rough estimate of ten days was made as the optimal period of evacuation from the unit to the base when operation had been performed. A conference was held in the Western Desert before the period of Alamein, following a report from Major-General Munro that abdominal patients were dying in Cairo as a result of premature evacuation by air from the desert. This showed that even air transport has deleterious effects. The Deputy Director of Medical Services, Eighth Army, presided and discussion took place, as a result of which a decision was reached not to evacuate patients with abdominal injuries before the tenth day and to provide beds and nursing facilities to ensure adequate nursing during the period. This decision was immediately implemented and has stood as the established procedure since then. However, a fixed period is impossible in cases that vary so much in their progress as do those associated with acute abdominal conditions. Sometimes patients can be safely shifted before the tenth day. I refer to thoraco-abdominal casualties without an abdominal incision. All patients following laparotomy should, I think remain the ten days so as to allow for firm wound repair. The number of patients with abdominal wounds is never very large in any one unit, though their nursing may be a strain on the staff. Every surgeon in a forward area and those at the base handling the patients after evacuation are in agreement that the patient who does not run a straightforward course should not be evacuated till any doubt as to his future is settled. We know that the patients dying at the base all die of sepsis. It is agreed that peritoneal infection is accentuated by movement, and experience at the base shows this all too clearly. The infected patient has a difficult uphill fight and often just pulls through. Shift him and he dies. The number of patients of this type is quite insufficient to clog the casualty clearing station, so there can be no real reason to shift them. I say dogmatically that it is wrong to shift any abdominal casualty whose condition is unsatisfactory. The treatment of the infected patient is, first, prevention by immediate and continued penicillin treatment, and second, complete rest in the unit where he has been operated on till he has recovered or his condition has become properly stabilized. This question of evacuation is of great importance when abdominal casualties are dealt with in field ambulances or other small and mobile units. A few of them can tie down a field ambulance and if they are dealt with during an advance several small units may be affected. This is a point in favour of performing abdominal operations in a more static unit, such as a casualty clearing station, and "leapfrogging" other casualty clearing stations forward to carry on the work, sending forward with the new unit naturally surgical teams from the old unit, which would not be required with the cessation of surgical activity. During the desert campaign our casualty clearing station often left behind a tent full of abdominal casualties in charge of one medical officer, the detachment to follow on when the patients were fit to be evacuated. Once we evacuated all our patients, some recently operated on, to another casualty clearing station near by. The results were extremely unsatisfactory and we never repeated the performance. We always left the patients in their own tent with personnel to look after them. I submit that, unless one is perfectly happy about a patient with an abdominal wound, then that patient must be held, even against administrative urging. The provision of plaster abdominal belts before evacuation is, I believe, uncalled for except in such abnormal circumstances as the forced evacuation of patients during retreat. If you consider the plaster necessary, then that patient should be held. We have had no deaths at the base for the last eight months, and I feel that there are only

two factors that could have helped: (*a*) penicillin given from the start, (*b*) non-evacuation of ill patients.

Maybe there may have been more deaths in the forward areas, but deaths from sepsis there have not been frequent, only two patients having had definite infection.

LATE POST-OPERATIVE TREATMENT.

Less than a week following operation there is commonly a secondary anæmia, so that further blood transfusions of from one to two pints are of the greatest benefit. The graphs of deaths show that there is a small peak at the sixth day, and this is in keeping with clinical observation. In the severe cases a crisis is always expected about that time, and it is at that time that the repeated blood transfusions are of such value in increasing the resistance of the patient to infection. Otherwise, except for definite intestinal obstruction, late treatment is largely expectant, with the drainage in the simplest manner, of any abscess that develops. Closure of the colostomy is now carried out as soon as the patient is safe and the condition stabilized—in rectal injuries, naturally, not till the rectum is healed. The lower bowel must be attended to by simple measures, so as to ensure that it does not become, and does not remain for days, loaded with a mass of hard fæces. This is distressful to the patient and interferes with his recovery. It is by no means uncommon, and manual removal is often required. As regards purgatives, I am always definitely a "no" man.

COMMENT.

I have presented the results of the treatment of abdominal wounds in the Second New Zealand Expeditionary Force during the campaign in Italy. Every patient is accounted for, dead or alive. The mortality is in conformity with other published figures. The treatment has been the standard treatment as evolved in the Western Desert. The only addition of importance has been the immediate treatment by penicillin. Blood transfusions remain the sheet anchor for resuscitation. In the average case the patient is not rushed on to the table till optimal improvement has been obtained. Hæmorrhage, however, is recognized and immediate operation performed. As accurate a diagnosis as possible of the extent of the injury is obtained before operation, and X-ray examination is utilized, especially in injuries possibly subdiaphragmatic or retroperitoneal in type. Simple liver injuries are treated expectantly if peristalsis is present and the general condition does not denote more serious lesions. Kidney lesions are also often treated expectantly. About the treatment of colonic lesions, especially in the caecum, it is impossible to be dogmatic, but exteriorization must remain the normal treatment for any marked colonic lesions. Thoraco-abdominal injuries should be treated preferably by thoracotomy. In gross liver injuries liver drainage should be adopted. When the peritoneum cannot be satisfactorily emptied of any abnormal fluid, or when infection is already present, temporary drainage is advised. Post-operative treatment by suction and intravenous administration of fluid follows ordinary routine. Blood transfusions are often indicated about the sixth day. Early protein feeding is now carried out and plasma is given intravenously in the early stages.

The results recorded are those of the work of our forward surgeons, for whom I have nothing but praise and admiration. They have worked strenuously and conscientiously with the welfare of each individual patient ever placed first. They have had to learn their work as they went along; but the unselfish passing on of knowledge from their own *confrères* and predecessors of the Second New Zealand Expeditionary Force, but just as much

from their comrades of the Royal Army Medical Corps and, in early desert days, of the Australian Imperial Force, has made the work easy and the progress of knowledge assured.

One must also acknowledge the excellent foundation laid by our friends Major-General Ogilvie and Brigadier Donald, the desert lions of surgery. We have been blessed by the presence in our casualty clearing station of excellent Royal Army Medical Corps surgeons, anæsthetists and forward transfusion unit officers, who have one and all helped us immensely both in our work and as a corrective to our insularity. We especially remember Andrew Lowden and Waterston in the desert, and Cope, Gouravitch and Bostock in Italy. We have been very lucky in our own forward surgeons, Stan Wilson, Keith Bridge, Allan Douglas, Tom A. Harrison in particular. We have been, I think, particularly lucky in our other ranks in the field ambulances and in the casualty clearing station. They have displayed great intelligence and have done constant, hard, tireless, gentle and sympathetic work. They have frequently done all the assisting of operations and nursing of the patients. Of our nurses at the casualty clearing station I have nothing but praise. We also owe much to the surgical ability and constant advice given by the commanding officers of the casualty clearing station, Eardley Button and A. G. Clarke, always present with wise counsel and always ready to take off their tunics to help.

It is a wonderful life in the forward operating unit, with its bouts of hard and continuous work, its responsibilities and its anxieties, and, above all, its good fellowship and its unselfishness. What a pity the atmosphere seems impossible to reproduce in civil life. The absence of pettiness, of class, of party politics, of sinister influences, is more than refreshing.

I have collected together our results as a tribute to the staffs of our forward units. I pay particular tribute to the work of our regimental medical officers and also to the work in our field ambulances. In the field I am confident that no medical service, and this refers to all ranks, has been better than that given by the New Zealand Medical Corps. In the casualty clearing station I hope we have been able to keep up with the high standard set by the Royal Army Medical Corps. That no deaths have occurred at the base during the last eight months means that our base hospitals have not failed us.

I am proud to have been associated with them all, and also proud of the results achieved. May the men and women responsible for these results obtain the reward and the future success that they deserve.

SUMMARY.

1. A series of 317 cases is presented, including all cases in the Second New Zealand Expeditionary Force during the Italian campaign. Deaths prior to admittance to medical units are also included. The patients were followed up to evacuation by hospital ship to New Zealand.

2. Approximately half the patients died, and of the deaths only 48 out of 160 took place later than forty-eight hours following injury.

3. Early deaths in the forward areas are due to the severity of the trauma. Later deaths in the forward areas are due partly to the trauma and partly to infection. Deaths at the base are all due to infection.

4. Very few patients were refused operation. At the casualty clearing station level, over 96% of the patients were operated on and only three patients were refused operation in our own casualty clearing station.

5. Of the patients who recovered, only 22 out of 157 were retained as graded men, the others being evacuated to New Zealand.

6. Of all the patients 50% recovered. Of all patients brought in alive to any medical unit 54% recovered. In all cases 61% of patients recovered, other than those who died quite unfit for operation.

7. No deaths occurred following exploration yielding negative results, and only three patients had completely negative findings.

8. Particulars are given of the mortality caused by different missiles and the severity of mine wounds is stressed.

9. The relative safety of thoracic exploration in thoraco-abdominal injuries is established and the high mortality in severe liver wounds is indicated.

10. Data with regard to the time of admission and of operation, following infliction of a wound are presented.

11. The condition of the patient on admission, immediately before operation and after operation is described.

12. The extent of the injuries sustained has been studied. One-third were hopeless, a third very severe and the other third severe.

13. Anuria was the most common and the most deadly complication. Preventive treatment by early intravenous administration of fluid is suggested.

14. Hæmorrhage, both primary and secondary, is discussed. The importance of mesenteric bleeding is stressed. The diagnosis of retroperitoneal hæmorrhage is discussed.

15. Sepsis is discussed and it is pointed out that since the institution of parenteral administration of penicillin from the onset at the casualty clearing station there have been no deaths at the base hospitals.

16. Details of the mortality in different injuries and combination of injuries are given. They are similar to other published figures.

17. Opinion is expressed with regard to the location and management of the forward operating units. The casualty clearing station is recommended as the best site for forward abdominal surgery. Staffing is discussed and the need for reliefs stressed.

18. The essentials of resuscitation are stated and post-operative treatment is described.

19. The optimal time for operation is discussed in the light of altered ideas concerning priority.

20. Operation on the different abdominal organs and the difficulty in dealing with the right side of the colon are discussed.

21. Evacuation of casualties to the base is dealt with, as well as the treatment of late infection.

ANTICOAGULANT EFFECT OF SPLEEN.[1]

By E. R. Trethewie,

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The spleen is frequently removed for therapeutic reasons. Often no reason is advanced in support of operation other than that patients have remissions of symptoms following splenectomy. In recurrent bleeding with thrombocytopenia and a normal coagulation time without retraction of clot splenectomy is advised. Some believe that an incision in the skin without removal of the spleen is equally beneficial. Troland and Lee[6] prepared an extract from thrombocytopenic spleens which caused a marked reduction of platelets. Quick (1942)[2] has indicated how little we know about blood coagulation. Seemingly, therefore, it is advisable to record any information available on anticoagulants, and in this paper it is shown that perfusion of the spleen with diluted heparinized blood endows the perfused fluid with increased anticoagulant effects.

Method.

Perfusion Experiments.

Under "Nembutal" anæsthesia (66 to 110 milligrammes per kilogram given intraperitoneally) the abdomen of dogs was opened to the right of the mid-line and 150 cubic centimetres of blood obtained from the aorta were heparinized and diluted in Tyrode's solution (1:3, 1:5 or 1:10). This fluid was used for perfusion and contained 0·0053 to 0·012 milligramme of heparin (Boots) per cubic centimetre. A cannula was introduced into the splenic artery and the *vasa brevia* ligated. The spleen was excised. Tyrode's solution was run through the organ to wash out blood and then the diluted fluid (above) was used for perfusion. The organ was perfused rapidly for ten minutes and then the flow reduced to 0·7 to 1·2 cubic centimetres per minute and perfused for 15 to 105 minutes. At first the spleen was laid on a glass platform and drained regularly by raising it. Thereafter the spleen was placed in a bath of Tyrode's solution kept at 37° to 38° C. (once 40° C.) and rubber tubing was used to lead the perfused material from the spleen, the vein having been cannulated. In some perfusions 3% carbon dioxide in oxygen was bubbled through the bath. The organ was weighed after perfusion. The hilum pointed upwards.

Control samples of fluid were obtained by introducing a syringe proximal to the perfusing cannula after agitation once or twice at the beginning (C_1, C_{1A}) and once at the end of perfusion (C_2) and the perfused fluid (P) was collected in a beaker. These samples were set aside to assess clotting in twenty-four hours after portions were examined for red cell and platelet counts, and portions were centrifuged and plasma was obtained for heparin and prothrombin estimations.

Heparin Determination.

Heparin (Boots) was used in all cases. Samples were tested for heparin by a modification of the method of Copley and Whitney (1944),[3] toluidin blue (Grübler) being used, as described previously (Trethewie and Melvin, 1945).[3]

[1] Accepted for publication on January 4, 1946.

This estimated heparin as heparin (Kahlbaum) and by applying a correcting factor (Trethewie, 1945)[5] the content as heparin (Boots) was determined.

Prothrombin Determination.

Control and perfused samples of plasma were tested for their prothrombin content by a modification of Quick's method (1942), as described previously (Trethewie, 1945).[4]

EXPERIMENTAL.

Size of Spleen.

It was noted when the organ was laid on the glass plate and perfused that before perfusion the organ was much larger. Thereafter the organ was immersed in a bath of warmed Tyrode's solution. The temperature of the bath in succeeding cases was 40°, 37° and 37° C. The spleen still did not stay relaxed. In one of these experiments acetylcholine was added to the perfusing fluid (Table I). The length was measured in two further cases

TABLE I.
Change in Size of the Spleen Following Perfusion.

Number.	Length Before Perfusion. (Centimetres.)	Length After Perfusion. (Centimetres.)	Percentage Reduction.	Temperature. ° C.	Type of Experiment.
7	19	15	21	37	
9	13	10	23	37	Acetylcholine.
6	11·5	11	4·5	38	CO_2 bubbling.
4	14	13	7·1	38	CO_2 bubbling.
3	15	14	6·6	38	CO_2 bubbling.

in which the temperature of the bath was 37° C., and it was noted (Table I) that the reduction in length was one-fifth to one-quarter. This means the volume was halved. Next, the Tyrode's solution in the bath was kept at 38° C. and carbon dioxide (97% oxygen + 3% carbon dioxide) was bubbled through the bath, and in this way only a slight reduction in length (4% to 7%) occurred (Table I).

Anticoagulant Effect of the Spleen.

When the heparinized fluid used for perfusion is allowed to stand, clotting occurs after some hours. Blood was obtained from a dog and diluted in Tyrode's solution 1 in 3, and varying amounts of heparin were added to different portions; 0·0025 milligramme of heparin per cubic centimetre was added to one, and 0·005, 0·0075 and 0·010 milligramme per cubic centimetre were added to the remainder. Small clots developed in the latter two and a large clot in the former two. In one control experiment (control 11, Table II) the experiment was set up exactly as in a perfusion experiment, except that no organ was perfused; 0·012 milligramme of heparin was added per cubic centimetre of perfusion fluid (0·06 milligramme per cubic centimetre of blood), and control and "perfused" (cannula collected) samples developed clots.

The anticoagulant effect of the perfused samples from spleen perfusions was determined, varying amounts of heparin being used. When 0·0053 milligramme of heparin per cubic centimetre of perfusion fluid was used in two experiments the perfused samples showed clots not quite as large as those of the control after twenty-four hours. In each, two samples of the perfused sample were tested, and two samples of the first control sample. When 0·0066 milligramme of heparin per cubic centimetre was used in one experiment, the perfused sample did not clot, while small clots were observed in the control

samples. In an experiment in which 0·0074 milligramme per cubic centimetre was used, neither the perfused nor control samples clotted. When 0·008 milligramme per cubic centimetre was used in another experiment, the perfused sample showed less clotting than the control samples. In one experiment, in which 0·0083 milligramme per cubic centimetre was used, the perfused sample had not clotted in three hours, while each of the control samples had at this time. The perfused plasma sample was xanthochromic. By the following day the perfused sample showed small clots, and clotting in the control samples had increased. When 0·012 milligramme per cubic centimetre was used no clots were detected in four perfused samples in one experiment, with varying rates of perfusion from 1·3 to 5·9 cubic centimetres per gramme of organ per hour. The plasma of the perfused samples showed varying degrees of xanthochromia. In another similar experiment no clotting appeared in specimens of perfused sample, and in the control samples clotting occurred. The amount of heparin per cubic centimetre of blood in each perfusion is shown in Table II, alongside the figure for that in the fluid used for

TABLE II.

Degree of Clotting (Twenty-four Hours) of Control Samples and Perfused Samples from Spleen in Relation to Heparin.

Experiment.	Heparin. (Milligrammes per Cubic Centimetre of Fluid.)	Heparin. (Milligrammes per Cubic Centimetre of Blood.)	Rate. (Cubic Centimetres per Gramme per Hour.)	Clotting.		
				C_1.	C_7.	P.
1	0·012	0·12	1·3 5·9 1·7 1·5	+	+	− − − −
2	0·0074	0·074	17·6	−		−
3	0·012	0·060	4·1 4·1	+ +	+	− −
4	0·008	0·040	1·1	++ +±	++	+± +
5	0·0066	0·033	2·9	+	+	−
6	0·0053	0·027	4·4 4·4	++ ++	++	+± +±
7	0·0053	0·027	4·8 4·8	++ ++	++	+± +
8	0·0083	0·025	0·7	+	++	+
Control 11	0·012	0·060		+	+	+

++ = large clot; + = small clots; +± = intermediate; − = no clots.

perfusions. It is seen that clotting did not occur in the perfused sample when heparin 0·06 milligramme per cubic centimetre of blood or more was used. In one experiment clotting did not occur in the perfused sample when 0·033 milligramme of heparin per cubic centimetre of blood was used.

In an experiment in which 0·0088 milligramme of heparin per cubic centimetre was added, clotting was not observed in one control sample, and only slight clotting in the other. More evident clotting was noted in the perfused sample. In this experiment, which does not appear in Table II, the perfused sample of plasma did not show increased xanthochromia and acetylcholine had been introduced (1 in 500) into the tubing proximal to the perfusing cannula at one-fifth the rate of the whole perfusion. Whether this affected the perfused spleen to inhibit its anticoagulant property by cutting off a pathway through the spleen has not been investigated.

Heparin Estimation.

Heparin in plasma was estimated as heparin (Kahlbaum). It was found that in general there was a slight drop in the heparin content—for example, in one experiment (experiment 1) the content in the control samples was 0·045 and 0·042 milligramme per cubic centimetre, while in the perfused samples it was 0·042, 0·042, 0·041 and 0·036 milligramme per cubic centimetre. If the correcting factor is applied, these figures were 0·011 and 0·011 milligramme per cubic centimetre, and 0·010, 0·010, 0·010 and 0·009 milligramme per cubic centimetre. This is in agreement with the findings with the perfusion of other organs (Trethewie, 1945).[4]

Prothrombin Estimation.

Estimations were made of the prothrombin content of the samples compared with a standard plasma. There was a fall in the prothrombin content after perfusion compared with the content of control samples in two of the perfusions; for example, in one experiment control samples contained 5% and 4% prothrombin, while the perfused samples contained 2%, 2%, 5% and 6%. In the other the figures were 55% and 52% for the control and 13% for the perfused sample. In two experiments there was a slight rise in the prothrombin content following perfusion. These findings are shown in Table III. In the remaining cases there was no evident change in the

TABLE III.
Prothrombin Content of Control and Perfused Plasma Samples.

Experiment.	Prothrombin Time. (Seconds.)			Percentage.		
	C_1.	C_2.	P.	C_1.	C_2.	P.
1	62·0 64·0	77·0 75·6	91·3 89·9 90·7 92·8 92·6 65·4 66·1 58·7 58·4	5	4	2 2 5 6
3	33·5 33·9 33·3	33·8 33·4 33·5	32·0 33·0	14	14	14
4	17·4 16·8 17·5	16·5 16·4 16·7	16·5 16·5 16·0	44	47	48
5	22·0 22·1 21·9	23·1 22·7 22·8	22·4 22·3 22·0	29	27	27
6	24·1 24·2 24·0	24·4 24·6 24·4	21·0 20·8 20·5	25	24	33
7	20·8 19·6 19·5	19·1 19·4 19·6	19·3 19·1 19·2	35	37	38
8	15·1 15·3 14·7	15·4 15·6 15·3	36·8 37·0 37·4	55	52	13
9	33·3 33·6 33·2	36·1 35·9 36·3	28·5 28·6 28·9	15	13	19
Control 10	15·0 14·8 14·4	14·3 14·2 14·3	14·4 14·5 14·6	57	60	59
Control 11	27·8 28·0 27·9	27·6 27·3 27·7	27·6 27·6 27·0	25	25	25

prothrombin content. Since no coagulation occurred in the perfused blood where the prothrombin content of perfused and control samples was unchanged (for example, experiment 3, Table III) it cannot be that changes in the prothrombin content account for non-coagulation.

Effect of Perfusion on Platelets.[1]

When an experiment is set up and no organ is perfused and a comparison is made of the platelet content of fluid obtained proximal to the cannula and fluid which has passed out of the cannula for collection, a fall occurs. This is shown in Table IV. The average content per cubic millimetre of the control samples was 352,500 and of the collected control samples 325,000.

TABLE IV.

Red Cell and Platelet Count (per Cubic Millimetre) of Control and Perfused Samples from Spleen. (Corrected for Whole Blood.)

Experiment.	Red Blood Cells.				Platelets.			
	C_1.	C_{1a}.	C_2.	P.	C_1.	C_{1a}.	C_2.	P.
3	5,500,000	4,300,000	5,800,000	4,400,000	460,000	175,000	240,000	250,000
4	4,750,000	4,100,000	3,100,000	3,200,000	250,000	400,000	600,000	1,000,000
6	5,700,000	3,700,000	4,400,000	7,200,000	850,000	650,000	900,000	600,000
7	—	—	—	—	600,000	—	740,000	480,000
9	3,480,000	3,160,000	2,400,000	3,100,000	540,000	760,000	660,000	480,000
Average ..	4,856,000	3,815,000	3,925,000	4,475,000		574,000		562,000
Control 10 ..	2,460,000	—	6,680,000	5,550,000	380,000	—	340,000	250,000
Control 11 ..	5,050,000	6,950,000	6,750,000	4,300,000	380,000	400,000	300,000	400,000
Average ..	3,755,000	6,950,000	6,715,000	4,925,000		352,500		325,000

In the case of the perfusion of the spleen the platelet content of the perfused fluid averaged 562,000 per cubic millimetre and that of the controls 574,250. Thus there was a fall of 2%, which is negligible. Now this is different from that which occurs with the liver of the cat. In liver perfusions from the cat in which blood was diluted in nine times its volume of Tyrode's solution (0·006 to 0·017 milligramme of heparin per cubic centimetre) the findings in five perfusions are shown in Table V. It is seen that the control

TABLE V.

Platelet Count (per Cubic Millimetre) of Control and Perfused Samples from Cat Liver. (Corrected for Whole Blood.)

Experiment.	Platelets.		
	C_1.	C_2.	P.
1	420,000	430,000	350,000
2	150,000	480,000	420,000
3	720,000	440,000	370,000
4	180,000	210,000	120,000
5	500,000	410,000	280,000
Average	394,000	394,000	308,000

[1] Thanks are due to Dr. O'Loughlin for the platelet and red cell counts.

samples contained an average of 394,000 platelets per cubic millimetre and the perfused fluid 308,000, a fall of 22%. In contradistinction the spleen, if these figures can be taken as correct, has not reduced the number of platelets passing through it.

Concerning the red cells, sedimentation makes sampling unreliable, though the findings are recorded in the table (Table IV).

DISCUSSION.

The spleen, like the liver, confers an anticoagulant property on diluted blood on passage through the organ. This effect was evident with a concentration of 0·033 milligramme and 0·06 milligramme of heparin per cubic centimetre of blood (0·007 and 0·012 milligramme per cubic centimetre of fluid) (Table II). With the liver the effective dose of heparin, allowing for the different type of heparin employed, was 0·12 milligramme of heparin per cubic centimetre of blood (0·012 milligramme per cubic centimetre of fluid). A dose of 0·055 milligramme was ineffective in the case of the dog liver (Trethewie, 1945),[5] and a dose of 0·040 milligramme per cubic centimetre of blood in the case of the spleen was ineffective. Thus the organs are comparable in activity. The anticoagulant effect is not due to loss of prothrombin, since the prothrombin content was unchanged where anticoagulant activity was detected. The effect is not due to heparin; the heparin content of the perfused sample is less. It seems likely that there is some anticoagulant material operating, as has been shown to be the case with the liver.

The platelet content of samples obtained from the spleen corresponds with that in the arterial blood. In control perfusions the platelet count of the fluid issuing from the cannula was a little less than that passing to the cannula. This differs from what is found in the cat liver; here a quite evident fall in the platelets is determined in fluid leaving the organ.

It seems that the spleen has an effect on blood, inhibiting coagulation, which is not related to platelet effect, and this may be responsible for some of the conditions of bleeding unassociated with platelet deficit.

SUMMARY.

1. A variation in the size of the spleen occurred following removal, and this effect was reduced by means described in the text.

2. When diluted heparinized blood is perfused through the spleen, the fluid develops increased anticoagulant activity, and this was found to be unassociated with alterations in the number of platelets in the fluid, or heparin or the prothrombin.

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THE INFLUENCE OF THE HIND LEGS AND PELVIS ON BLOOD COAGULATION.[1]

By E. R. Trethewie,

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Much has been written concerning the development of thrombosis in the veins of the legs and pelvis. The frequency of pulmonary embolism bears testimony to the importance of this happening. It would seem that there is some fundamental reason for this to occur. In this paper an endeavour has been made to determine the reason for this phenomenon.

Method.

Heparin Estimation.—Heparin (Boots) was used throughout and assayed in diluted plasma as described previously (Trethewie and Melvin,[4] 1945).

Prothrombin Estimation.—Prothrombin was estimated in the diluted plasma as described previously (Trethewie,[3] 1945).

Perfusion Experiment.—The abdomen of the cat was opened under "Nembutal" anæsthesia (60-120 milligrammes per kilogram given intraperitoneally). Blood was obtained from the aorta, heparinized (0·14 to 0·28 milligramme per cubic centimetre) and diluted in nine times its volume of Tyrode's solution. A cannula was placed in the aorta pointing distally and perfusion was begun with Tyrode's solution. The abdominal vessels of supply to the colon were ligated and the organ was divided between ties in the pelvis. The trunk was cut across at the level of the arterial cannula and a cannula was introduced into the one or two large caval vessels returning the perfused fluid. The hindquarters so obtained were laid with the cut end a little lower than the remainder, which was regularly raised so as to encourage venous return. A rubber tube was connected to the cannula leading off the perfusion fluid. The ovarian, uterine and vaginal vessels of a cat that was pregnant were also ligated. After rapid perfusion with Tyrode's solution for ten minutes the diluted blood was used for perfusion, and after another ten minutes the flow was reduced to one to fifteen cubic centimetres per minute. Samples of perfusion fluid were obtained with a syringe introduced proximally to the arterial cannula at the beginning and end of perfusion (C_1, C_2). The perfusion fluid (P) issuing from the venous cannula was collected in a beaker for ten to thirty minutes. Sometimes more than one sample (P_1, P_2) was collected, the rate of flow having been altered. A portion of each sample was set aside for twenty-four hours and observed for clotting. Readings were made as described previously (Trethewie,[3] 1945).

Experimental.

The hind legs and pelves of nine cats were perfused. Samples of perfused and unperfused blood were set aside to allow clotting to develop. Heparin had been added in a concentration of 0·014 milligramme per cubic centimetre of perfusion fluid in four cases, 0·02 milligramme per cubic centimetre in two, and 0·028 milligramme per cubic centimetre in another. We found that in six experiments the perfused samples developed more marked clotting than

[1] Accepted for publication on February 6, 1946.

the controls. In two the clotting in control and perfused samples was equal, and in one the control sample showed more clotting than the perfused. The experiments are recorded in Table I.

TABLE I.

Experiment.	Sex.	Added Heparin. (Milligrammes per Cubic Centimetre.)	Perfused Sample.			Degree of Clotting.			
			Volume. (Cubic Centimetres.)	Time. (Minutes.)	Cubic Centimetres per Gramme per Hour.	Control.		Perfused.	
						C_1.	C_2.	P_1.	P_2.
1	M.	0·014	52	30	0·102	+±	+±	++	
2	M.	0·014	44	14	0·15	++	−	++	
3	F.	0·014	43	30	0·108	+	+	+	
4	F. (Pregnant)	0·014	19 24	15 15	0·061 0·076	<++	++	++	++
5	M.	0·014	40	30	0·054	++	++	<++	
6	M.	0·014	45	30	0·066	+±	+±	++	
7	F.	0·02	17 36	15 15	0·076 0·16	>±	>±	+	<+
8	F.	0·02	90 58	6 4	0·67 0·64	++	++	++	++
9	F.	0·028	22 63	15 15	0·11 0·34	±	>±	<+	>±

++ = large clot; + = small clots; > = a little more; < = a little less; ± = trace; − = no clot.

This is quite different from that which occurs with the liver, kidney, lung, spleen and heart. In the first-mentioned four, with this heparin concentration the perfused sample shows no clotting or only very slight clotting (Trethewie,[1] 1945,[2] 1946). With the brain clotting of the perfused sample may be greater than of control samples (Trethewie,[2] 1945).

The increase in clotting of perfused samples might be due to a fall in the heparin content of the perfused fluid. The heparin content of the control and perfused samples was estimated as heparin (Kahlbaum) and the figures are recorded in Table II as heparin (Boots) by applying a correcting factor

TABLE II.

Heparin Concentration of Control and Perfused Samples.

Experiment.	Weight of Heparin Added (Boots) in Milligrammes per Cubic Centimetre.	Heparin Estimation.			
		C_1.	C_2.	P_1.	P_2.
1	0·014	0·012	0·014	0·015	
2	0·014	0·012	0·011	0·012	
4	0·014	0·014	0·013	0·011	0·011
5	0·014	0·010	0·010	0·010	
6	0·014	0·010	0·010	0·009	

(Trethewie,[2] 1945). In experiment 1 it is shown that 0·014 milligramme of heparin (Boots) per cubic centimetre was added to the fluid and control samples contained 0·012 and 0·014 milligramme of heparin (Boots) per cubic

centimetre by estimation. The perfused sample contained 0·015 milligramme of heparin per cubic centimetre. In this experiment the perfused sample showed more evident clotting than the control, and this cannot be due to a fall in the heparin content. In experiments 4 and 6 there was a slight fall in the heparin content and in 2 and 5 it was unchanged. These figures are within the limits of experimental error. In 2, 4 and 6 there was increased clotting of the perfused samples. In investigations on perfusing organs (liver and kidney) there was a fall in the heparin content (Trethewie,[1] 1945) in all, but the perfused samples developed no or very little clotting. It seems unlikely that heparin can be related to the difference in clotting of control and perfused samples, though the difference is only slight.

Estimations of prothrombin show a difference between the content of control and perfused samples. The nearness of the times for repeat tests gives such a method more accuracy in distinguishing slight differences. In four instances the prothrombin time for the perfused samples was markedly less than that of the control. The difference of the means was considerably greater than the difference of repeat tests of the same sample (Table III); for example, in experiment 6 the control figures were 52·6 and 51·9 seconds. The perfused sample gave 41 seconds as the prothrombin time. The standard

TABLE III.

Prothrombin Time of Plasma.

Experiment.	Time. (Seconds.)				Prothrombin Percentage.			
	Control.		Perfused.					
	C_1.	C_2.	P_1.	P_2.	C_1.	C_2.	P_1.	P_2.
1	63·3 63·4 62·0	61·2 61·7 60·5	69·6 67·4 65·4		5	5	4½	
2	56·5 63·2 64·0	61·7 62·0 61·5	78·8 77·8 69·7		5	5	4	
3	84·3	68·8 68·4 69·0	70·0 97·2 71·2		3	4	3½	
4	36·2 34·8 35·4	38·5 38·0 38·6	35·8 37·2 37·8	40·7 41·3 40·2	13½	12	13	10½
5	72·6 73·1	71·4 72·0 71·7	59·2 68·0 66·2 58·7 57·9		4	4	5	
6	52·9 51·2 53·0 53·2	51·5 52·2 51·3 51·7	41·3 40·2 41·4		6	6½	10½	
7	50·0 48·2 49·3	51·3 53·5 50·2	45·0 45·4 44·9	43·8 41·9 42·1	7	6½	8½	10
8	71·6 79·8	73·5 75·1 78·0	54·5 54·2 53·9	57·0 58·1 56·9	4	4	6	6
9	>4 mins.	>4 mins	44·0 41·5 40·4 44·2	52·4 54·8 53·9 59·0	<1½	<1½	10	6
Average					5½	5½	7	

deviations in the former were ± 0·9 and ± 0·4 second, and in the latter ± 0·7 second. In one experiment (experiment 5) there was a difference in means of the same order, but not such a small variation. Of the remaining four, in two the prothrombin time was unaltered and in two a rise occurred in the perfused sample. The difference in prothrombin time is more apparent when an increased amount of heparin is added to the perfusing fluid. This also shows how considerable may be the heparin content and yet clotting still occurs in the perfused sample. For example, in experiment 9, 0·028 milligramme of heparin per cubic centimetre was added to the perfusion fluid and the control samples did not clot in the prothrombin assay even after some minutes. The perfused samples clotted in 43 and 55 seconds.

The mean "prothrombin" content for control samples as given by the graph (Trethewie,[1] 1945) for these times was 5·5% and 5·5% (Table III). The mean of the perfused samples was 7%. This is in agreement with the greater clotting of the perfused sample, and in view of the method employed and that the sample was passed through the preparation only once, it indicates a not inconsiderable difference in "prothrombin" content.

In the case of the liver and kidney perfusions there was always a fall in the "prothrombin" content, which was marked in the latter.

DISCUSSION.

The development of pulmonary embolism is related to the formation of thrombi in the vessels of the leg and pelvis. We are not concerned in this work with dislodgement of the clot, but with determining just why clot development is so favoured in this region.

It has been shown that the liver, kidney and lung (Trethewie,[1] 1945) endow diluted perfused blood with anticoagulant effects. In the case of the liver this has been found to be effected by an output of an anticoagulant which is not removed from plasma by lipin solvents. The spleen also endows perfused fluid with anticoagulant effects (Trethewie,[3] 1946).

On the contrary, the heart and brain do not act similarly. The fluid after perfusion through the heart is almost as coagulable as control fluid, and after perfusion through the brain is as coagulable or more coagulable than before (Trethewie,[2] 1945).

In the case of the hind legs and pelvis we find that the fluid is a little more coagulable after perfusion than before, and this has been estimated as "prothrombin". The mean content of the perfused fluid passing to the legs and pelvis was 5·5% and of the perfused fluid after perfusion 7%. It seems that the increase in coagulation is due to an output of a clotting substance which may be prothrombin.

SUMMARY.

1. When the hind legs and pelvis of the cat are perfused with diluted heparinized blood, the perfused fluid is more coagulable than the control.

2. The "prothrombin" content of the perfused samples is a little higher than in the controls.

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PULMONARY HYDATID DISEASE: THE SIGN OF THE CAMELOTE.[1]

By James A. Jenkins,
Dunedin.

Hydatid cysts of the lung may present unusual radiological appearances, and one of these has been likened by South American surgeons to the Camelote, a plant that grows on their rivers and in appearance resembles a water-lily. This and certain other appearances peculiar to lung cysts are stated to be pathognomonic of hydatid disease and are reported frequently in Argentine medical literature, but appear to be uncommon in reports from other countries. The very extensive bibliography following an article by Davidson[1] in *The Journal of Thoracic Surgery* makes it apparent that these signs, though relatively infrequent in lung cysts, do occur sufficiently often to make them worthy of report.

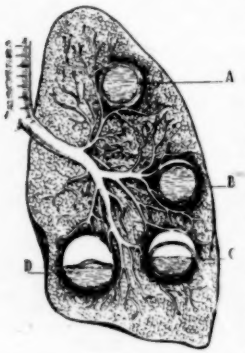

Figure I.

A comprehensive review by Barrett and Thomas[2] also mentions these signs. Figure I, a diagram from a paper by Jose Arce,[3] shows the commoner varieties of air-containing cysts. A paper by Benson, Evans and Zuelzer[4] described the process whereby a bronchus is gradually eroded by the impinging cyst until it eventually communicates with the potential space between the adventitious pericyst and the hydatid membranes. Air entering this space was, according to Dévé, first said to have been observed by Zehle in 1916. Its diagnostic importance was not appreciated until 1933, when Caeriro and Goyena, of Buenos Aires, again described it. The term "perivesicular pneumocyst" was applied by Marquio Bonaba and Soto of Montevideo in 1934. Other terms, *"carlotte aerienne"* or "air cap", "arc sign", "pneumoperi hydatid", "sign of detachment", have also been applied. (See "B", Figure I.)

This sign is said to be pathognomonic of hydatid disease and to occur in 3% of lung cysts. Air may come and go in this space, but the presence of the air cap is usually a prelude to early rupture of the cyst into a bronchus. With rupture of the cyst and some loss of fluid the membranes may fall away from the pericyst and an arc of air may appear under the pericyst with a second arc within the membranes above the fluid level.

This was described by Cumbro in 1921 and has been called the "double arc sign" by other authorities. (This is illustrated by "C" in Figure I.)

Should sufficient air enter to cause complete separation and collapse of the hydatid membrane with loss of much of the hydatid fluid through the bronchial fistula, a characteristic wavy mass of parasitic membrane lies within the air-filled pericyst, moving within the cyst on a small amount of remaining fluid. It is this appearance that is known radiologically as "the sign of the Camelote". (See "D", Figure I.)

[1] Read at a meeting of the Royal Australasian College of Surgeons at Dunedin, August, 1945. Accepted for publication on October 8, 1945.

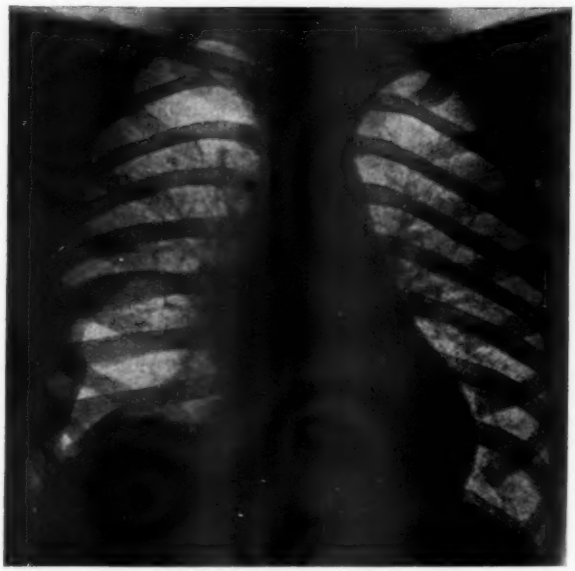

FIGURE II.

CASE RECORD.

A female child, aged six years, was referred to me in October, 1944, with a tumour in her right lung. Her history was that in June, 1944, she had suffered from left-sided pneumonia. She had not been well since then and at intervals had developed raised temperatures with vomiting. She had no cough or sputum and gave no history of coughing up any fluid or other material at any time. She had no dyspnœa and was stated by her parents to be a healthy, active child apart from the recurrent attacks of fever. On investigation all systems were normal apart from eneuresis.

On examination she appeared to be a rather frail child. There was deficient air entry with very faint breath sounds over the lower part of the right lung anteriorly.

She brought with her skiagrams of the chest. The first was taken in August, 1944. The radiologist's report described a cystic change in the base of the right lung and suggested that the chest be reexamined further. Reexamination in November, 1944, showed no essential changes, and the radiologist's report confirmed her previous suggestion that this child had a cystic lesion in the base of the right lung. The opinion was given that it was a hydatid cyst. The suggestion was further made that it was in the middle lobe. A Casoni test was carried out and the result was negative.

On November 3, 1944, under gas and oxygen and local anæsthesia a wide thoracotomy was carried out. The lung was adherent to the diaphragm and chest wall and mediastinum. After it had been partly separated, a yellowish-white cyst about 10 centimetres in diameter was found occupying the position of the middle lobe. Aspiration of the cyst yielded air only, and the tension of the cyst appeared to vary with the tension under which the gas was being administered.

FIGURE III.

The middle lobe of the lung, most of which was occupied by the cyst, was freed. The vessels were ligated and the lobe, together with the hydatid, was removed. The bronchus was closed by interrupted cotton sutures and the end was buried in adjacent pleura. A drainage tube was inserted and a negative pressure water seal applied.

Convalescence was without incidence and the tube was removed five days after operation. The patient was discharged from hospital with a soundly healed wound and in good general condition twenty days after operation.

The radiological appearances (Figures II and III) show very clearly the "sign of the Camelote".

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RESECTION OF THE BLADDER NECK IN THE FEMALE, WITH REPORT OF A CASE.[1]

By BERNAYS MELVILLE,
Melbourne.

A CONDITION of the female bladder neck for which the correct treatment is an endoscopic resection of part of that bladder neck has been described in various papers since 1921, when John Caulk first drew attention to it.

The result of this condition is an advanced degree of chronic urinary retention. The usual causes of residual urine in women, such as cystocele, urethral stricture and neurogenic bladder, are not connected with this condition, though possibly they may be associated. The outstanding symptom is that of urinary obstruction, so pronounced that in at least one recent paper the condition, both on symptoms and pathological findings, was referred to as the female prostate. Thus Folsom and O'Brien read a paper entitled "The Female Obstructing Prostate" before the Section of Urology at the ninety-third annual session of the American Medical Association in June, 1942. In this, after reviewing the literature on the subject, they pointed out that in 1931 Folsom first emphasized the clinical importance of the group of glands surrounding the posterior part of the female urethra. He felt then, as he still does, that infection harboured through the years in these glands is probably the cause of the bizarre pathological picture seen in this portion of the female urethra. These authors are convinced that "prostatism" is a clinical entity that is seen much more frequently in women than is recognized and properly treated, because physicians have not fully realized that such conditions do exist and do cause all the clinical symptoms that are seen in similar conditions in men. The majority of cases which they have seen, as well as those reported, "show a fibromuscular hypertrophy with fibrous hyperplasia and varying grades of inflammatory reaction". In some cases actual gland structures have been reported and seem to be identical with those seen in similar lesions in the male. For years Folsom and O'Brien considered these cases in males to be "an end result of an old chronic prostatitis of varying degrees of severity and showing a variety of types of reaction, and since we now have ample pathological evidence that there is a group of glands surrounding the posterior part of the female urethra, which Caldwell goes so far as to identify as strictly a homologue of the prostate in the male, we may with propriety assume that the two pathological entities are in fact identical".

In the discussion which followed, it was apparent that whilst the main observations were agreed to, the use of the term "female prostate" was objected to by several speakers; for example, Kretschmer said: "Females do not have prostates".

Hinman in his "Principles and Practice of Urology", states:

> The para-urethral glands, Skene's ducts and the peri-urethral glands (tubular glands of Folsom) all have similar origin and are prostatic homologues. "Acinous in character and covered with a two row low cylindrical celled epithelium." These acini may harbour concretions which resemble those of the prostate.

Van Duzen, objecting to the use of the term "female prostate", has stated that the prostate is a physiological structure in the male which forms

[1] Accepted for publication on September 24, 1945.

a part of the semen and he does not believe that anyone has claimed that function to exist in the female. He points out how divergent are the views of writers on the question of the presence of glands in the female urethra. One group states they are present, another denies this and states that what are supposed to be glands are actually lesions of *cystitis cystica*. Van Duzen has studied the matter at some length and his conclusions are:

1. Examples of *cystitis cystica, cystitis nodosa* and *cystitis glandularis* are found in the female urethra.

2. Glands are present in the posterior portion of the urethra in the female embryo, but these regress. Some may persist and may take on development in later life — for example, because of androgen-œstrogen imbalance.

3. Glandular hypertrophy is seen in the posterior portion of the urethra of women.

4. These do not represent prostatic glands.

It seems apparent that these various writers are agreed in their main contentions that there is some similarity in the changes that may occur in both male and female periurethral glands and/or bladder necks. The controversy concerns the use of the term "prostate gland", and it is probable that it should not be used, for it is apparent that most urologists now agree that what is usually called the enlarged prostate is not an enlarged prostate at all, but a development of the inner periurethral glands at and about the bladder neck, which compresses the true outer prostate as it expands.

The cause of the obstruction is obscure. Gershom Thompson discussed the whole subject before the American Urological Association in 1938 on the basis of a group of 24 women who were treated at the Mayo Clinic. In this group chronic inflammation was the most important factor in the causation of such dysfunction of the vesical neck, but because chronic urethritis in women is quite common and this condition relatively uncommon, there must be other factors. What these are is not certain.

Some showed hypertrophy of the internal sphincter as observed through the retrograde cystoscope, and pieces of excised tissue revealed large bundles of muscle which seemed hyperplastic. Œdema of subepithelial tissues—probably as a result of inflammation—and hyperplasia of the superficially lying epithelium at the vesical neck were observed in microscopic studies of several cases. No glandular tissue was discovered in these sections (compare this statement of Thompson's with those of other authors). Increase in the amount of fibrous tissue at the vesical neck, such as is seen in men, was apparently present in sections stained by Van Gieson's method. However, similar abnormal amounts of fibrous tissue were found in sections taken from women who died of causes unrelated to the urinary tract and whose urinary tracts were found on examination to be normal. Therefore Thompson concludes that something other than fibrosis is responsible for the retention of urine in such cases. The possibility of a nervous imbalance between the sphincteric and detrusor musculature leading to spasm of the sphincter and subsequently to hypertrophy and possibly hyperplasia has been suggested by Braasch and Thompson. Some evidence in favour of this suggestion was present in some of his cases.

SYMPTOMS.

According to Thompson, the cardinal symptoms in these cases are those of urinary obstruction, and there may be others due to the complications of this condition. Thus there may be difficulty in voiding urine, undue straining, frequency, nocturia and "incontinence" due to an overflow retention.

Evidences of pyelonephritis, moderate renal insufficiency, hydronephrosis and infected urine may be observed in a proportion of cases.

A large amount of residual urine will be found in each case and the degree of urinary difficulty may progress to absolute retention of urine, needing occasional or even repeated catheterization for its relief. The duration of such complete retention may be for months or years.

The cystoscopic findings are striking because of the paucity of evidence of obstructing deformity at the bladder neck. Only by close inspection may evidence of stiffening or contracture be noted. In a few cases, with a retrograde lens, a welt of tissue surrounding the bladder neck may be observed. However, the evidences of back pressure on the bladder are similar to those seen in cases of urinary obstruction in men; thus we find trabeculation, cellules and sacculation. In a few cases the vesical wall is smooth, apparently thin and atonic in appearance.

DIAGNOSIS.

Diagnosis is made on the following evidence: (*a*) extreme urinary difficulty; (*b*) retention of a large amount of residual urine, especially if supported by evidence of back pressure on the bladder.

If appropriate neurological examination excludes the diagnosis of neurogenic bladder, Thompson then proceeds to a modified excision of the bladder neck, employing the Thompson cold-punch resectoscope.

It was my good fortune to have been associated with Thompson in the care of several such patients, and the results of operation were dramatic. The following case history constitutes an excellent example of the condition and its treatment.

I.C., female, single, housekeeper, aged fifty-seven years, attended the Alfred Hospital on July 3, 1944, complaining of "bladder trouble; frequency, difficulty, scalding". Nine years before, she had her first attack of "cystitis" with great frequency, scalding and pain, but no straining. The next attack was six months later, with the same symptoms. A spell of very good health followed until in 1940 she had a very severe attack; she had another in 1941 and yet another in 1942. With them all she never had any straining, only the desire to pass water every few minutes, with scalding. Then about six months before, she noticed that when she had the feeling to pass water she could not do so unless she strained, and even then would pass only a little, and in a little while again the desire would return, with the same result. At this time, during the day she would have the feeling to pass water about fifteen times and at night-time six or seven times. "I could not say what quantity I passed, but I felt it was very little, and it would take some time to pass that. I could feel that my bladder was never empty, and at times felt very uncomfortable. Then the straining became so intense I felt I would burst a blood vessel in my efforts to relieve myself."

General examination revealed nothing of note—the patient was healthy looking and of average build. She was given a mixture containing potassium citrate and tincture of hyoscyamus.

The following investigations were carried out and the results are as follows. General microscopic examination of a catheter specimen of urine was carried out. The centrifuged deposit showed about ten leucocytes per high-power field. Chemical examination of urine revealed no abnormality. With the Ziehl-Neelsen test of the urine no tubercle bacilli were detected.

According to the X-ray report, opacities were present in the lower part of the abdomen on the right side; some at least were thought to be due to calcified glands, but calculus could not be excluded. Phleboliths were present lower down in the skeletal pelvis. The right renal outline was not defined. Chronic osteoarthritis and sacralization of the right side of the sixth lumbar vertebra were present. The costal cartilages were calcified.

The excretion urogram report was that the left kidney had a normal function; the pyelogram was within normal limits, although the calyces were not clearly defined. No abnormality was detected in the left ureter. The right kidney had good excretion. The kidney was high in the abdomen, but otherwise was apparently normal. No

abnormality was detected in the right ureter. No calculus was detected. Kinking appeared to be present at the right pelvi-ureteric junction.

On July 17, 1944, the patient reported that she still had to strain to urinate. She was referred for cystoscopy. According to my report of July 24, 1944, no narrowing was present in the urethra. Sound E, 12/16, passed easily. Very good distension was obtained. Areal cystitis grade 1 was present. Trabeculated bladder grade 2 was noted. Cellules and small diverticula were seen. The posterior lip of the internal meatus was slightly raised.

FIGURE I. Shows inflamed mucosa with dense collections of leucocytes, surface denudation and nodular epithelial masses formed by partial replacement of glands by stratified epithelium. × 45.

At this stage the diagnosis of contracted bladder neck was made and residual urine check, neurological and gynæcological opinions were asked.

The residual urine amounted to 18 ounces.

The gynæcological department's report of July 31, 1944, stated that the patient was *virgo intacta*. She had passed urine at 8 a.m. and could not pass it since. What appeared to be a large central cyst was present. The bladder was catheterized and 20 ounces of urine were drawn off. Vaginal examination revealed a clear pelvis.

Dr. Leonard Cox reported that no evidence of organic neurological disease was present.

She was sent for admission to hospital for resection of the bladder neck. Several weeks elapsed before she was admitted, and at each visit to the out-patient department she complained of the distressing straining: "All the time, the straining was getting so bad that I had a bowel movement every time and I was really thankful when I was admitted to hospital."

She was admitted to hospital on October 1, 1944. Operation was postponed for two weeks because of slight rise in temperature and urinary infection (pus and Gram-negative bacilli were present in the urine). The infection was brought under control with sulphanilamide, fifteen grains three times a day, and potassium citrate, 40 grains four times a day, and a high fluid intake.

Residual urine checks in this time resulted in eight and a half ounces and ten ounces being obtained.

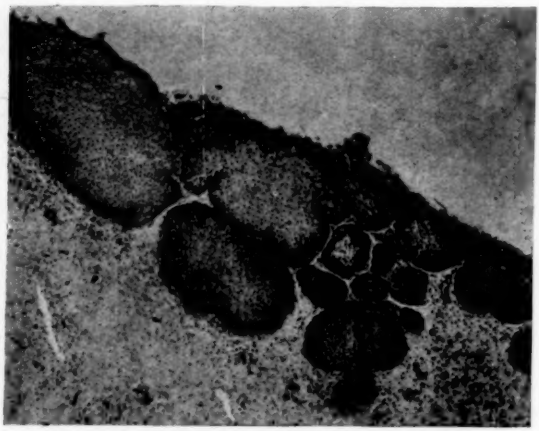

FIGURE II. Shows an area of markedly nodular thickening of the surface epithelium. × 45.

Operation was performed on October 17, 1944. Under low spinal anæsthesia (8% "Novocain") the 27 French gauge Thompson cold-punch resectoscope was introduced. A chronic granular urethritis grade 2 was present. The bladder neck itself showed nothing of note beyond a slight ridge across the floor. While care was taken not to open the fenestrum more than one-quarter of an inch, the whole circumference of the internal meatus was resected,

about 15 to 20 small pieces of tissue being removed. This was done so that all irregularities were removed, and the final result was a perfectly round orifice. Bleeding was slight, and what there was could be easily controlled by fulguration of a few small spurting vessels. A Foley hæmostatic bag with two-way irrigation was introduced and a constant drip irrigation was set up. Convalescence was uneventful, the hæmostatic bag being replaced in thirty-six hours by an ordinary self-retaining catheter, and this was removed on the sixth post-operative day.

Her residual urine was checked. At first it was between three and five ounces of urine, but when she moved more freely round the ward and used the toilet instead of the bed-pan it fell to three-quarters of an ounce and then to nil. Since this the patient has voided freely and easily.

She was discharged from hospital on October 31, 1944. The last report from her includes these words: "And now I feel as if life is worth living, for my desire to pass water is very normal (without any straining), about four times during the day, and I go right through the night without being disturbed."

FIGURE III. Shows the fragments of tissue removed.

The following report on the specimen was received from Dr. Rupert A. Willis:

> The specimen consists of small fragments of tissue, the largest measuring about nine millimetres long, microscopically consisting of urethral mucosa, connective tissue and smooth muscle, with the following changes.
>
> (*a*) Inflammatory changes comprise collections of inflammatory leucocytes, mainly lymphocytes, increased numbers of small blood vessels, and areas denuded of surface epithelium and partly converted into granulation tissue.
>
> (*b*) Epithelial hyperplasia is prominent in both the surface epithelium and the subjacent glands. The surface epithelium shows areas of nodular thickening, with exaggerated folds and irregular indentations into the subjacent inflamed tissues. The glands, which are of the Littré mucous type, show overgrowth; and there is prominent extension of the stratified surface epithelium into and around the glands, or possibly metaplasia of the glandular epithelium itself into stratified epithelium.
>
> It is this change in the glands which is largely responsible for the nodular mucosal thickening and the apparent downgrowths of the surface epithelium into the subjacent tissues.
>
> The whole picture closely resembles that of many urethral caruncles.

SUMMARY.

1. Contraction of the bladder neck in the female is discussed.

2. A case is reported in a female, a *virgo intacta*, neurologically normal, of a condition causing (*a*) great difficulty in urination, (*b*) high residual urine, (*c*) evidence of back-pressure in the bladder, and therefore diagnosed as a contraction of the bladder neck, completely relieved by resection of the neck of the bladder.

ACKNOWLEDGEMENT.

I should like to thank Dr. Rupert A. Willis for his help in preparing specimens and giving the above pathological report.

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Case Reports.

EMPYEMA OF INTRAHEPATIC GALL-BLADDER: REPORT OF A CASE.[1]

By W. R. Lane,
Melbourne.

Among the developmental abnormalities which may occur in connexion with the biliary system, that in which the gall-bladder is situated within the liver substance is, though well recognized, not a common occurrence.

The condition was first described by Dévé in 1903, before the Anatomical Society of Paris. McNamee[1] was able to collect a total of only 25 cases recorded until 1933, and described two additional cases; but he states that the condition probably occurs more frequently than the number of reported cases would indicate.

As far as can be ascertained from the available literature, no instance of empyema occurring in an intrahepatic gall-bladder has been reported previously. It is felt, therefore, that the present case should be recorded.

Of McNamee's 27 cases, 14 (including Dévé's original 12 cases) were found at autopsy in infants. Of the 13 cases in adults, the majority of patients first presented themselves with a history of biliary colic (with or without jaundice) or of a gall-bladder type of dyspepsia, or of both, and in the majority of cases gall-stones were present. A feature of the present case is the complete absence of any previous symptoms referable to the biliary system.

Of cases recorded by McNamee, in only two was the gall-bladder situated completely within the liver: in one of these incision of the liver substance led to severe and uncontrollable bleeding from which the patient died. This difficulty did not arise in the present case, since, although a depth of approximately three-quarters of an inch of liver substance was traversed to reach the gall-bladder, there was no bleeding from the cut edges. This was presumably because the acute infective process had caused thrombosis in the vessels of that part of the liver immediately surrounding the gall-bladder.

Cholecystectomy has been successfully carried out in some of these cases by enucleating the gall-bladder from within the liver substance (Stetten[2]), but the operative mortality appears to be very high, and it would seem that simple cholecystostomy is the procedure of choice. In the present case, with the gall-bladder already the site of empyema formation, removal would almost certainly have been technically impossible and no attempt was made to carry it out.

Clinical History.

The patient, a married woman, aged forty-nine years, was first seen on July 7, 1945, when she gave the following history. Two days previously she had felt pain beneath the right costal margin, not of severe degree and not radiating; it was relieved by application of heat and did not interfere with sleep. The following morning the pain recurred with increased severity, but was still "not very bad"; the pain varied in intensity and was still localized to the right hypochondrium. During the next twenty-four hours the pain gradually increased in severity, and for the first time radiated to an accurately localized area at the angle of the right scapula. The intensity of the pain continued to fluctuate, but for two or three hours before the patient's admission to hospital had been constant and very severe; during this period also the patient had had two rigors. There was no nausea or vomiting and the bowels were normally opened twenty-four hours before the patient's admission. The colour of the motion was not seen, but the urine had been dark since shortly after the onset of the pain.

There was no relevant past or family history.

On examination the patient looked "toxic" and ill and was obviously in severe pain. Her temperature was 102·6° F., the pulse rate was 108 and the respiratory rate 24 per minute. The right upper quadrant of the abdomen was acutely tender on palpation, with maximal tenderness localized to an area just below the rib margin and lateral to the right rectus muscle. Muscle guarding was well marked over the right hypo-

[1] Accepted for publication on December 17, 1945.

chondrium, but it was possible to feel an indefinite mass, moving with respiration, beneath the area of greatest tenderness.

A pre-operative diagnosis of empyema of the gall-bladder was made, and two hours later, under open ether anæsthesia, the abdomen was opened through a right upper paramedian incision. When the peritoneum was opened, œdematous and congested liver presented, extending well below the rib margin, with omentum adherent to its under surface. When this was separated no gall-bladder was to be seen or felt in the normal situation, but on palpation of the liver a fluctuant area was found in the lower and lateral part of the right lobe. Aspiration of this area produced thin bile-stained pus at a depth of three-quarters of an inch from the surface, and, after the area had been packed off from the general peritoneal cavity, the liver substance was incised along the needle track.

There was no bleeding from the cut edges of the liver, and when the cavity was entered several ounces of bile-stained pus, together with three small faceted gall-stones, were evacuated. Approximately thirty more faceted stones were then removed by a spoon, and one stone was found impacted in a duct-like prolongation of the cavity which extended downwards and medially. After removal of this stone, a malleable probe was passed into this duct, and thence into the common bile duct, which was then palpable in a normal position and was not dilated.

The abdomen was then closed around a large drain tube placed within the cavity. It was felt that the patient's condition did not justify any further dissection.

Post-operatively the convalescence was uneventful. There was profuse bile-stained drainage from the tube for the first four days, after which the wound gradually became dry and was healed by the fifteenth day.

The temperature became normal on the fifth day and remained normal thereafter, and there was no evidence of biliary obstruction at any time after operation. The abdomen was normal on palpation on the patient's discharge from hospital, and since discharge her health has been good and there have been no complaints other than that of a slight serous discharge from the site of the drain tube at intervals.

Although for final proof a section of the cavity wall should have been found to be histologically identical with gall-bladder wall, and a more complete demonstration of the relation of the cavity to the duct system should have been made, the patient's condition at the time of operation did not justify the additional operating time involved, and it would appear that the presence of typical faceted gall-stones within the cavity, together with its demonstrable connexion with the common bile duct, is sufficient proof of the nature of the condition.

Summary.

A case of empyema occurring in an intrahepatic gall-bladder is described and the relevant literature briefly reviewed.

Two points particularly worthy of notice are the complete absence of any previous history of biliary disease and the very rapid progress to empyema formation from the onset of the first symptoms.

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(1) E. P. McNamee: "Intrahepatic Gallbladder", *American Journal of Roentgenology*, Volume xxxiii, May, 1935, page 603.

(2) De W. Stetten: "Cholecystectomy in a Case of Intrahepatic Gall-Bladder", *Annals of Surgery*, Volume xcvii, February, 1933, page 296.

CHYLOUS ASCITES, WITH REPORT OF A CASE TREATED BY VENOUS-PERITONEAL ANASTOMOSIS.[1]

By EARDLEY BUTTON,
Wellington, New Zealand.

THE main causes of chylous ascites are: (*a*) trauma, producing a rupture of the thoracic duct, and (*b*) disease of the lymph nodes, causing pressure on the duct, with resulting extravasation of chyle into the peritoneal cavity. A case of chylous ascites is reported, in which venous-peritoneal anastomosis was used in treatment.

Clinical History.

The patient, a girl aged ten years, was referred from a country district. According to her history, she developed at the age of five years a transitory swelling of her abdomen, which lasted some three weeks and cleared up completely with rest in bed. No paracentesis of the abdomen or other special investigation was carried out at this time. The child carried on a normal life for four years, until April, 1944, when this accident occurred. She was running through her house, chasing another child, when she collided with the edge of a bench, striking the left side of the upper part of her abdomen. Her mother stated that she was temporarily knocked out, but was not sufficiently ill for a doctor to be called in. Some fourteen days later the mother noticed a prominence of the child's abdomen and took her to her doctor. The abdomen continued to increase in size and the presence of fluid was demonstrated. In view of her previous history a tuberculous peritonitis was suspected and a laparotomy was done, when the presence of chyle in the peritoneal cavity was demonstrated. This was aspirated and the abdomen was closed without further treatment. Fluid reaccumulated in the peritoneal cavity, and successive tappings of the abdomen were necessary; by February, 1945, the intervals between tappings had gradually decreased from three months to two weeks. On each occasion 160 to 180 ounces of chyle were withdrawn. The child slowly lost condition and was admitted to Wellington Hospital on February 26, 1945. Examination at this time showed a thin child, with a grossly distended abdomen (Figures I and II). Her temperature was 98·4° F., her pulse rate 100, and her respiratory rate 20 in the minute. She was pale, with sunken eyes. The veins of the neck were distended and the ribs and sternum prominent. Dulness was present over the lower part of the chest on both sides, apparently from a tenting of the diaphragm. The lungs otherwise showed a good air entry and the breath sounds had no accompaniments. The apex beat was displaced upwards to the third interspace in the mid-clavicular line. The heart rhythm was normal and the sounds were clear. The abdomen was grossly distended and showed a well-healed scar of a lower abdominal laparotomy. There were also scars of various paracenteses in the left iliac fossa. Shifting dulness and a fluid thrill were present. There was no œdema of the ankles. Reflexes were

FIGURE I.

FIGURE II.

[1] Accepted for publication on September 18, 1945.

normal. Paracentesis was done on the day following admission to hospital, and 180 ounces of milky chylous fluid were withdrawn.

Reports on investigation were as follows. The ascitic fluid contained a large volume of chyle. A wet preparation showed a few lymphocytes. No organisms were seen. On X-ray examination of the chest and abdomen following paracentesis there was no evidence of chronic adhesive pericarditis or of calcification in the chest or abdomen.

A blood count revealed the following information:

Red cells, per cubic millimetre	6,010,000
Hæmoglobin content	17 grammes (100%)
Mean corpuscular hæmoglobin	28·5γγ
Leucocytes, per cubic millimetre	13,500
Neutrophile cells	82%
Lymphocytes	11%
Monocytes	5%
Eosinophile cells	2%

The red cells appeared normal.

The urine had an acid reaction and was free from albumin. The deposit consisted of a few epithelial cells.

The serum protein content was 4·1 grammes per 100 cubic centimetres. The serum albumin content was 2·9 grammes per 100 cubic centimetres. The serum globulin content was 1·2 grammes per 100 cubic centimetres. The ratio of albumin to globulin was 2·4 to 1. Total non-protein nitrogen content was 22 grammes per 10 cubic centimetres. The blood sedimentation rate was 15 millimetres in one hour. The Mantoux test (1 in 1,000) gave an indefinite reaction.

FIGURE III.

FIGURE IV.

The child was put on a diet with a high protein content and full vitamin requirements were supplied. Fats were restricted. Paracentesis was repeated on March 12 and on March 22. On each occasion 160 ounces of chylous fluid were withdrawn. On April 11 further blood examination showed the total serum protein content to be 4·5 grammes per 100 cubic centimetres. The ratio of albumin to globulin was 1·2 to 1. There was some improvement in the general condition. Paracentesis was again repeated on April 12 and 160 ounces of fluid were withdrawn. Operation was performed on April 13 under local anæsthesia, "Novocain" 1%, supplemented with nitrous oxide and oxygen (Dr. Rix).

The abdomen was opened by a right paramedian incision and the chylous fluid was removed by suction. The parietal peritoneum was much thickened, and together with the peritoneum of bowel and mesentery gave the appearance of a bright red, velvety surface. The mesenteric and aortic glands were moderately enlarged and fleshy in appearance. There was no obvious glandular enlargement about the region of the *receptaculum chyli*. There was no enlargement of liver or spleen. Venous-peritoneal anastomosis was decided upon. An incision was made over the line of the right internal saphenous vein over the upper half of the thigh. The vein traced distally soon divided into two branches. Both branches were used in the subsequent anastomosis by dividing them in the middle of the thigh and leading them up through a subcutaneous tunnel passing from the saphenous opening to a point low down in the right iliac fossa. At this point an additional abdominal incision one and a half inches long was made at the outer edge of the right rectus muscle. The end of each vein was then split for a distance of one centimetre and was sutured to the inner surface of the parietal peritoneum with fine silk so that the mouth of the vein was held open. The valve at the saphenous opening was competent, as there was no efflux of blood during this procedure. Suture of the abdominal wounds and the wound of the thigh concluded

the operation. The general condition of the child was satisfactory. Intravenous therapy was continued for twenty-four hours after operation, during which time 300 cubic centimetres of blood, 600 cubic centimetres of plasma and 800 cubic centimetres of a 5% solution of glucose were given. Convalescence was uneventful. The abdomen remained flat, with no evidence of free fluid, and the general condition and nutrition of the child improved markedly. Investigation on May 8 showed the total serum protein content to be 6·3 grammes per 100 cubic centimetres (normal 6 to 8 grammes per 100 cubic centimetres). The red blood cells numbered 4,460,000 per cubic millimetre and the leucocytes 7,700 per cubic millimetre. The hæmoglobin content was 12·8 grammes (75%). The child was up on May 7 and was placed on a full diet with no restriction in fats. Her weight increased from four stone on May 7 to four stone four pounds on May 27. Daily measurement of the abdomen showed this to be steady at twenty-one and a half inches, there having been no reaccumulation of fluid since operation. The child was discharged home, apparently fit and well, on June 1, 1945 (Figures III and IV).

Comment.

This child had wasted gradually in the nine months following the accident to her abdomen. This wasting and the frequent paracentesis of her abdomen necessary made of her a chronic invalid. The cause of the leakage of chyle is difficult to assess. There is the suggestion of a tuberculous peritonitis four years previously. There is no record of the presence of chyle in the ascitic fluid at that time. At her laparotomy in April, 1945, the glands in the mesentery were moderately enlarged. No other evidence of tuberculosis was seen, and it was thought that the condition of the glands could have been secondary to the marked irritation of the peritoneum from the chyle present in the abdominal cavity. There was a definite relationship between the trauma to the abdomen and the occurrence of the chylous ascites. At no time was there any œdema in the lower limbs or the abdominal wall, so it is suggested that the lymphatic obstruction occurred in the root of the mesentery distal to the *receptaculum chyli*. Thus it appeared that a venous-peritoneal anastomosis might offer her some relief. The anastomosis was done on the right side because of the presence of adhesions in the left iliac fossa. The internal saphenous vein in a child is of small calibre and all precautions were taken to avoid intimal damage and subsequent thrombosis. The omentum in this case was firmly fixed at the site of paracentesis in the left iliac fossa and could not reach the area of anastomosis. This practical point is considered important, as the omentum could otherwise block the orifice of the vein. If the omentum is free it should be excised.

On August 20 her doctor reported that the child was very well and living a normal routine for her age. The deformity of the chest, caused by the splaying out of her lower ribs, had disappeared. There was no evidence of any reaccumulation of fluid in her abdomen, and she was due to resume school in the spring term, commencing September, 1945.[1]

Acknowledgement.

My thanks are due to Mr. H. F. McNickle, to whose care the child was admitted, for his help and criticism, and for the opportunity to operate on this case.

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[1] A further examination of the child, July, 1946, showed her to be symptom free. Her abdomen appeared normal. Her weight was five stone eight pounds, and she was leading the normal life of a schoolgirl of her age.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

THE TREATMENT OF FRACTURES BY THE USE OF THE INTRAMEDULLARY NAIL.

Zentralblatt für Chirurgie, November 13, 1943, pages 1641 to 1659.

THIS number of the *Zentralblatt* is entirely devoted to articles on the use of the intramedullary nail in fractures. Maatz describes variations in the form and use of it to get better results; Vogl discusses its value in reconstruction surgery; Herzog reports a piece of apparatus he has devised for the better control of the fragments; and Pleifer presents an instrument he has made for the extraction of the nail.

Maatz, *"Über Formschlüssigkeit bei der Küntscher-Nagelung (Neue Nagelformen)"*, describes the difficulty of fitting the usual nail, regular in diameter throughout its length and U-shaped in cross-section, into the varying diameters of the medullary canal in the different bones, so that it will hold firmly. He states that faulty stabilization of any fracture depends on the shape of the medullary cavity, on the nature of the fracture, on the site of the fracture, on the site of introduction of the nail and on the shape of the nail itself; and he proposes modifications of the standard nail. His primary modification is that the nail should be in general conical and tapering rather than of even size throughout.

For fractures of the humerus, whose medullary cavity is widest at its upper end, the site of insertion is at the upper part, among the fibres of the deltoid. For proper stabilization it depends on the actual shape and width of the cavity whether success will be achieved by simply using two nails or whether it will be better attained by driving a conical wedge down between them after they have been inserted. Special nails are required for the ulna and other particular bones. Maatz's views on the treatment of fractures in the subtrochanteric region of the femur are indicated by illustrations in which (*a*) he represents the standard form of nail and (*b*) his own conical nail. In fractures lower down in the shaft long nails are driven the whole length of the bone, with oblique "springing" tips, which spread out in the farther end of the cavity to obtain a purchase against the surrounding cortex. Nails for each form of fracture and their different method of use are described in detail which may be omitted here.

Vogl's contribution (*"Die Marknagelung in der Wiederherstellungschirurgie"*) deals with the use of the standard nail in reconstructive surgery of malunited and ununited fractures, in which he claims results unequalled by any other method.

He reports seven cases, illustrating various advantages of the use of the nail. The first is a fracture of the upper third of the shaft of the femur which had united in an extreme *varus* position with shortening so that walking was impossible. Osteotomy was performed, and after very little freshening of the bone ends a vertical intramedullary nail was put in place, entering through the great trochanter. This patient walked with a straight leg in eight weeks. The second case was one of a gunshot fracture of the second metacarpal with very bad displacement of the distal fragment in a volar and radial direction. Both of the extensor tendons were destroyed. The nail in this case protruded five centimetres out of the skin, beyond its site of insertion, and in spite of sterile dressings infection occurred during the four weeks in which the nail was left in place. Nonetheless, when it was removed the fracture was found to be firmly united. In a third patient, who had suffered a gunshot wound fracturing the ulna, which had left a pseudoarthrosis and in which the innervation of the flexors of the first two fingers had been destroyed, a long nail was driven in almost the whole length of the bone and a plastic operation on the tendons was performed. Six weeks later full movement was possible in all directions. This nail was left in place for six months before being extracted. Its elasticity, and the consequent evenness of the pressure it exerts, keeps the surrounding bone firmly in place. Withdrawal is easy. In the fifth case it is stated that the nailing of a fracture of the upper part of the shaft of the humerus was undertaken at the same operation in which sequestra were removed, and a fistulous sinus was curetted. A glass drainage tube was inserted for eight days, and after its removal healing was quite uneventful. Vogl states in this connexion, that provided all dead tissue is removed and adequate drainage is provided, the presence of old infection in a wound is not a contraindication to the use of the

nail. He also claims that the use of an intramedullary nail is a great aid in obtaining proper incorporation of a simultaneously inlaid bone graft.

Herzog (*"Verbessertes eigenes Hebelgerät zum Ausgleich der Seitenverschiebung bei Bruchen der langen Röhrnknochen zur Anwendung bei der Marknagelung"*) describes an apparatus he has devised to assist mechanical replacement of the fragments and their control during the nailing operation. It is a simple device. The gripping arms are of metal, and the normal curve of them is of a radius of six to eight centimetres. They are adjusted by set screws on the smaller arm of a long bent rod, which is square in section. This simple lever controls and manipulates the fragments. Herzog points out that the pressure exerted by this lever is considerable, and where it is exercised over a subcutaneous surface, such as the tibial crest, this should be protected by padding.

Finally, Josef Pleifer (*"Einneues Instrument zum Herausschlagen der Marknagel"*) describes an extractor for the nail, which is made of steel. The author claims ease and certainty of extraction with its use.

ARTHUR E. BROWN.

A METHOD OF EXPOSURE OF THE VERTEBRAL ARTERY.

K. E. Herlyn (Göttingen): *"Zur Freilegung der Arteria Vertebralis"*, *Der Chirurg*, Volume xv, December 15, 1943, page 713.

AFTER quoting Vogeler's statement about the extreme difficulty of ligating the vertebral artery, Herlyn states that he has had to perform this ligation four times in a series of 150 operations for aneurysms of all sorts. In two of these four cases the aneurysm was in the first part of the vessel and ligation presented no special difficulty. In the other two the aneurysm, a traumatic one, involved the second and third parts, and in these two also the operation was carried out without undue difficulty.

Free access and a wide exposure are essentials, for the danger of recurrent hæmorrhage is very great, and everything must be done under vision. There being no branches in the first two divisions of the artery, simple proximal and distal ligation of the vessel is sufficient to enable the aneurysm to be excised.

The incision recommended runs along the sterno-mastoid muscle, curving backward at the lower end towards the clavicular head; and at the upper end curving backward also below the ear to the occipital region. The first part of the artery can be reached by separating off the sterno-mastoid muscle and opening up the space revealed. The omo-hyoid and the scalenus muscles are cleared, the phrenic nerve, the veins and the thoracic duct are seen and avoided. It is quite easy to dissect down onto the sixth cervical transverse process and thus to identify the artery and tie it along with its veins.

For operations in the second part of the vessel, the large cervical vessels are displaced outwards and the thyreoid is drawn inwards. Blunt dissection in the loose tissue round the œsophagus and larynx brings the dissection without difficulty down onto the bodies and transverse processes of the cervical vertebræ. The nerve roots of the cervical plexus are well out of the way of this anterior approach. The anterior part of each transverse process is carefully nibbled away by forceps, the artery thus being exposed lying in its canal. In spite of the fragility of its walls it may be quite easily freed under full vision, and by the use of instruments devised for the purpose it can be underrun and tied with comparative ease.

If it is necessary to expose the third part of the artery, the curved upper end of the incision is deepened, the sterno-mastoid muscle is displaced backwards so as to expose the spinal accessory nerve, and the strong, deep neck muscles (the splenius and semispinales) are split in the line of the incision and this gap is opened out. By this means the transverse process of the atlas is reached and the vertebral artery, with the suboccipital nerve, can be identified. The artery, provided it is not too badly affected by pathological changes, is quite easily loosened and ligated. By carrying the skin incision still further posteriorly, and also still further splitting the deep muscles, the artery can be traced as it courses round the upper border of the arch of the atlas to reach the *foramen magnum*.

ARTHUR E. BROWN.

Reviews.

Acute Injuries of the Head. By G. F. ROWBOTHAM, B.Sc. (Manchester), F.R.C.S. (England); Second Edition; 1945. Edinburgh: E. and S. Livingstone. 9¾" × 6¼"; pp. 440, with 201 illustrations (13 in colour). Price: 30s. net.

WITH the appearance of the second edition of "Acute Injuries of the Head" Mr. Rowbotham sets a still higher standard in surgical monographs. The production of

this lavishly illustrated and well-printed book during war-time is quite remarkable. The original text of the first edition has been extensively revised and several new chapters have been included.

The opening chapters deal with the mechanisms of injuries to the head and the resulting pathological changes. Here the author has introduced the important contributions made by Holbourn on the physical effects produced during the injury. The varieties of concussion are interpreted in the light of the earlier experimental work of Denny Brown and Russell. To the acceleration concussion which they describe, the author has given the name diffuse neuronal injury. Although the pathological description of this condition which follows is at times overclouded by theoretical considerations, the account given of the three primary pathological states—contusion, laceration and diffuse neuronal injury—is as clear and concise as our present knowledge of these subjects permits.

The chapter on the diagnosis of closed injuries of the head is the most outstanding portion of the book because the author shows how essential it is to make an accurate estimate of the state of consciousness and shows how variations in the level of consciousness may be observed and recorded. A grouping or classification based upon the state of unconsciousness is outlined, which is of considerable importance from the point of view of operative treatment. But perhaps the most valuable portion of this chapter is the collection of case records and the discussions which conclude the chapter.

In regard to the surgical treatment of both closed and open head injuries, there are several well illustrated chapters on surgical technique, which provide complete instruction in the surgery of cranio-cerebral injuries. General nursing and non-operative treatment are also provided for. The merits of dehydration treatment are reviewed and the dangers of this form of treatment are explained.

Detailed consideration is given to the late effects of head injuries in a manner which indicates how well acquainted the author must be with all the phases of this work. The problems of litigation and the difficulties of making an accurate assessment are discussed in detail. The causes of post-traumatic headache receive considerable attention, and although the reader may not accept the theory suggested for the origin of headaches of the migrainous type, the review is full of relevant and interesting information. On the psychiatric side changes in disposition and intellect are clearly outlined, though they do not, perhaps, receive the full consideration which the frequency of their occurrence would merit.

Rehabilitation is the subject of one stimulating chapter in which the author gives the results of experiences in war-time organizations. Rehabilitation for the injured must continue in the post-war years, and it would appear that the organizations described in this chapter can be modified to meet the demands of the civilian worker in peace-time.

A final chapter on birth injuries completes this excellent monograph. In the second edition Mr. Rowbotham firmly establishes his book as one of the medical classics of the war years, and a book of real value to both practitioners and surgeons in the years of peace when cranio-cerebral injuries may well be more frequent than in war.

The Principles and Practice of Rectal Surgery. By W. B. GABRIEL, M.S., F.R.C.S.; Third Edition; 1945. London: H. K. Lewis and Company, Limited. Royal 8vo, pp. 432, with 237 illustrations and 11 colour plates. Price: 45s.

THE third edition of "The Principles and Practice of Rectal Surgery", by William B. Gabriel, appearing seven years after the second edition, has been enlarged to 432 pages and presents a more complete account of this branch of surgery than has appeared before. The book reflects the methods in use at Saint Mark's Hospital, London, and is written from an essentially practical point of view. It is excellently illustrated. This edition brings the work up to date with regard to operative technique and statistics, and includes new chapters on proctitis and squamous-cell carcinoma of the anus and anal canal.

Most surgeons will agree that the treatment of so-called "minor" rectal complaints is too often followed by unsatisfactory results. In this volume the author adopts the important attitude that minor surgery does not exist, and he provides that detailed information upon which success depends. The approach is always anatomical.

In the chapter on anæsthesia, "Pentothal" is recommended for shorter rectal operations, but the advice that it may be conveniently followed by ether overlooks the troublesome laryngospasm which often results from this sequence. The section on the operative treatment of hæmorrhoids has been rewritten. The author has now adopted Milligan's technique of hæmorrhoidectomy and pays it the compliment of describing no other operation. More detailed advice has been provided on the difficult problem of partial rectal prolapse in adults, while for complete prolapse it is noteworthy that

Gabriel still advises amputation as the operation of choice. The chapter on *fistula in ano* has been improved by the addition of several excellent illustrations; however, it is doubtful whether the proportion given for tuberculous fistulæ (15%) is applicable in Australia or New Zealand. In the treatment of pilonidal cysts Gabriel still regards excision and leaving the wound open as the best treatment for more than half his cases. A minor inaccuracy is the statement that since the cyst and related sinuses are always superficial to the bone, the coccyx need never be excised. For *pruritus ani* the author now sees no indication for surgical treatment, and the description of the operation for division of the inferior hæmorrhoidal nerve, included in previous editions, is omitted.

In the chapter on carcinoma of the rectum Gabriel describes in detail only his own operation of choice—a one-stage perineo-abdominal procedure, which he has now performed more than 400 times. It is interesting to note that he still uses this method rather than the synchronous combined technique in lithotomy-Trendelenburg position now employed by his colleagues at Saint Mark's Hospital, and becoming increasingly popular in this country. Spinal rather than general anæsthesia is now advised. Perineal excision is advocated only in aged subjects or as a palliative measure. The chapter again includes most useful information on post-operative treatment and colostomy management.

This is a book which should be in the library of every surgeon and general practitioner.

A Textbook of Surgical Pathology. By C. F. W. ILLINGWORTH, M.D., Ch.M., F.R.C.S. (Edin.), and BRUCE M. DICK, M.B., F.R.C.S. (Edin); Fifth Edition; 1945. London: J. and A. Churchill, Limited. 9″ × 6″; pp. 735, with 306 illustrations. Price: 42s.

THIS fifth edition follows very much in the sedate and down-to-earth manner of its predecessors. Shock and burns are discussed with some reference to recent work, and the point is made that while after burns the initial stage of primary shock due to reflex vasomotor paralysis is usually more brief than that after other traumatic stimuli, the second stage continues progressively and becomes worse in the succeeding two or three days. This phase usually results in loss of plasma and a resultant hæmoconcentration. The crush syndrome, which is characterized by renal failure after crushing of a limb, is also discussed. The section on wound healing has been rewritten, and emphasis is placed on the delay in wound healing which may be caused by infection, particularly in the presence of streptococci, hypoproteinæmia, and deficiency of vitamin *C*. It may be said that the book closely follows its predecessors and is just as much to be recommended for its clarity, brevity and common sense as were the previous editions.

Annals of the University of Otago Medical School, 1875-1939. By D. W. CARMALT JONES; 1945. Dunedin: Coulls Somerville Wilkie, Limited. 8½″ × 5½″; pp. 286, with 12 illustrations.

THIS book contains a detailed account of the founding of a university and a medical school under conditions that would have daunted any but the stoutest heart, and even then any but Scotsmen with an inborn passion for education.

In 1873 James Macandrew, the Superintendent of the Province of Otago, directed the University Council to proceed with the foundation of a medical school, and by persistent effort provided the first financial swaddling clothes. Then came John Scott, Daniel Colquhoun, Lindo Ferguson, and so the tale goes on: if not always Scottish, then very nearly always so.

Quite early in the desperate effort to survive, the young school turned to the Universities of Melbourne and Sydney for such friendly advice as they, in their early nonage, might give; nevertheless there was always an instinctive and filial devotion to the University of Edinburgh. That the school did survive was due to the utter self-sacrifice of its early staff and in later years to the generous support of the people of the Dominion as a whole, and those of Dunedin in particular.

Professor Carmalt Jones has made the dry bones live, and the book is rich in the vivid portrayal of men and the qualities of their mind.